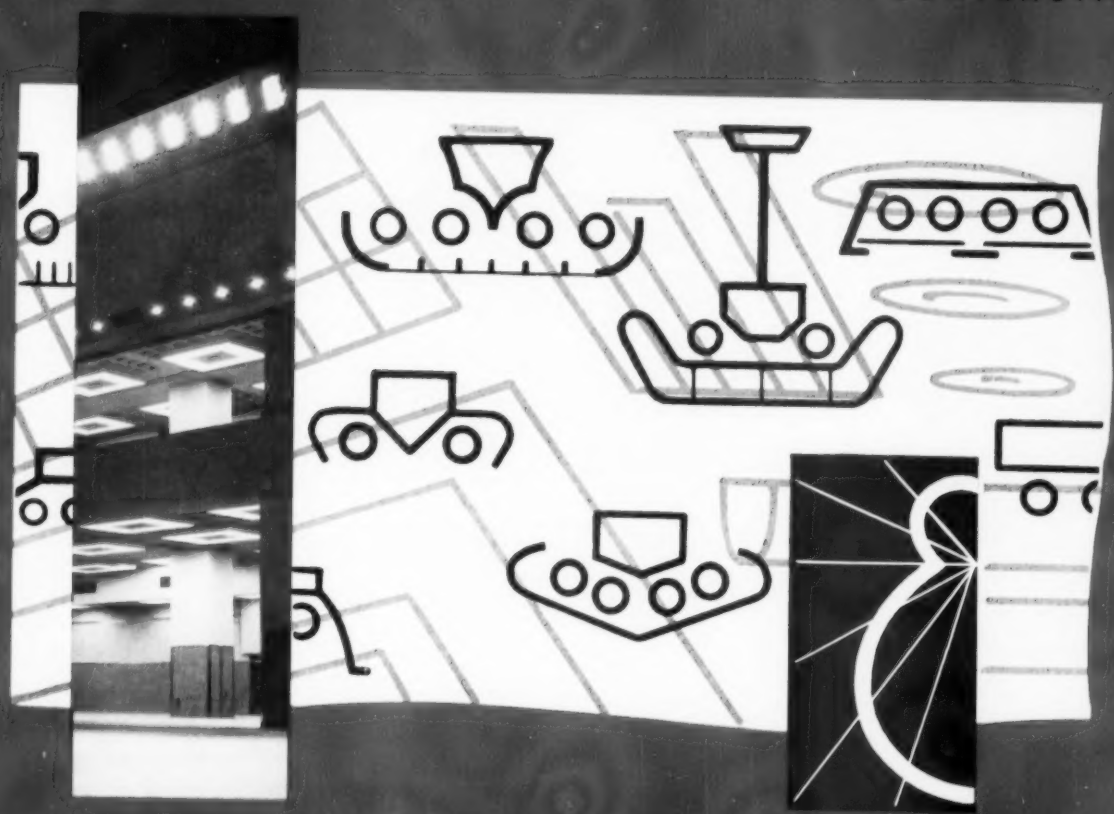
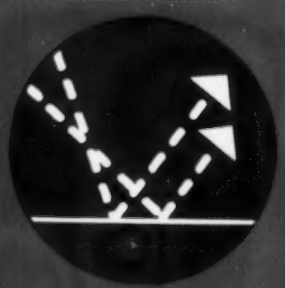
OCTOBER • 1957
PRICE 40 CENTS

ELECTRICAL CONSTRUCTION AND MAINTENANCE

WITH ELECTRICAL CONTRACTING



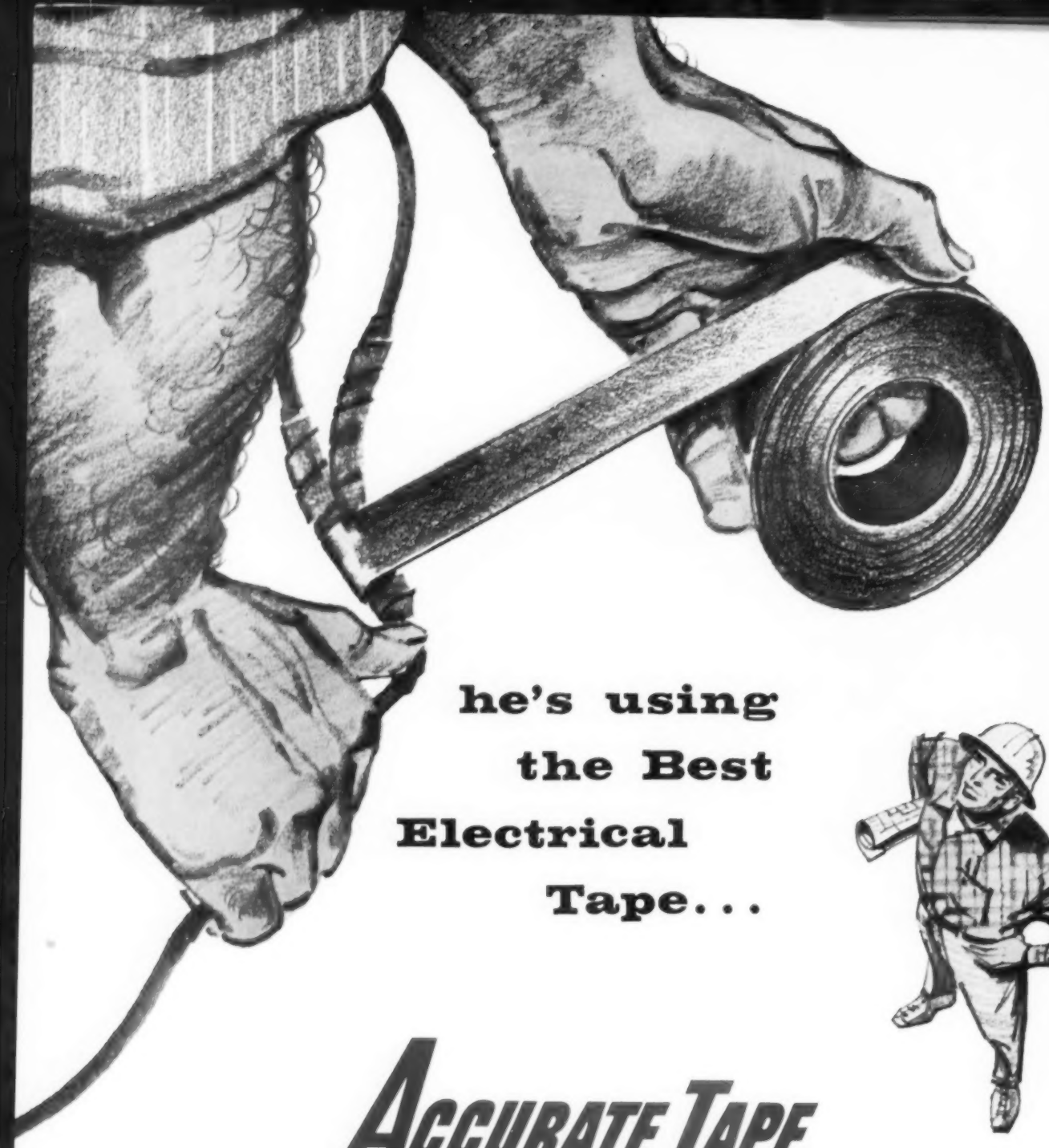


APPLIED LIGHTING

Layout and Design Data for the practical application of modern lighting systems and components.

page 105

A McGRAW-HILL PUBLICATION | 57TH YEAR



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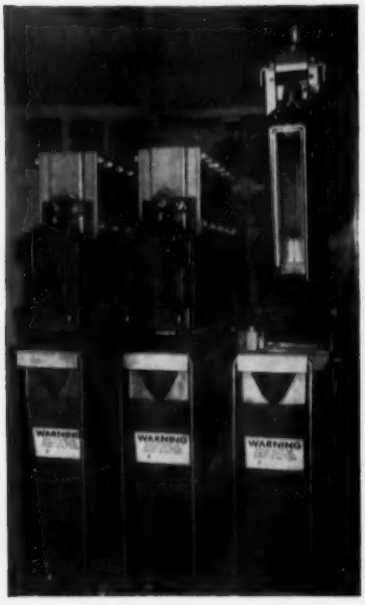
METAL-CLAD SWITCHGEAR

PURIFIED PORCELAIN in horizontal and vertical bus supports, primary disconnect bushings and caps and epoxy in bus joint covers provide excellent insulation, prevent fires in 15 kv I-T-E metal-clad switchgear.



EPOXY AND SPECIAL CERAMICS protect personnel and equipment by preventing fires in the circuit breaker section. Arc chute rear supports and blowout coils are epoxy. Jump gap cooling plates, arc chute liner plates, arc plates and spacers are special ceramics.

Only the finest fire-protective insulating materials

Nonflammable porcelain and ceramics, flame-resistant epoxy, and other flame-retardant insulating materials throughout, are among the extra values you find in I-T-E Metal-Clad Switchgear. Purified porcelain, of which the primary disconnect bushings and caps are made, also supports both vertical and horizontal bus. It is nonflammable, has high dielectric strength, won't track or deteriorate, is inherently contamination free.

Epoxy, which can be molded into complicated shapes, forms arc chute rear supports, blowout coils, bus joint covers, potential and current transformers. It has high mechanical and dielectric strength, is nontracking and extremely flame resistant.

Special ceramics, highly resistant to direct arc exposure, are used in jump gap cooling plates, arc chute liner plates, arc plates and spacers. These have high dielectric strength, low moisture absorption, won't track, are excellent interrupting materials. They do not deteriorate when subjected to direct arc exposure. They absorb thermal shock and deionize gases without excessive heating.

Phenolic and polyester insulating sheets and moldings, specially treated to provide the highest possible degree of flame-retardant characteristics, are also used.

If you are planning new construction or modernization requiring electric power, consider the advantages of I-T-E equipment. Consult your local I-T-E sales office or write I-T-E Circuit Breaker Company, 19th & Hamilton Sts., Philadelphia 30, Pa.

I-T-E CIRCUIT BREAKER COMPANY • Switchgear Division

IN CANADA: EASTERN POWER DEVICES, LTD.

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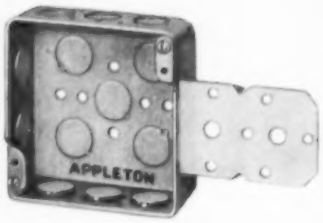

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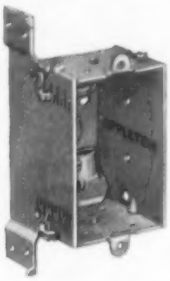
Concrete Rings and Boxes
Extension Rings
Bar Hangers and Bar Sets
Handy Boxes and Covers

SWITCH BOXES



Featuring "notched" clamp screws which can't fall out . . . Single screw adjustable plaster ears to cut adjusting time in half . . . Easy to remove horseshoe pryouts . . . Gripping ridges to hold cable in place on bottom . . . Inch marked sides with 4 nail holes (side pryouts and 2 top nail holes eliminated) ...and NEW "NAIL-IN" BOXES.

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Weathertight 90° Pulling Elbows

For 90° connections requiring a pulling fitting where space is limited, these new weathertight units give excellent service. Large cover for easy access with full, neoprene gasket providing the finest possible weather seal. Wiring chamber has smooth chamfered edges throughout with similar treatment on conduit hubs: tapered threads. Galvanized blank steel cover and zinc-plated screws contribute to making the new APPLETON Weathertight 90° Pulling Elbow your best possible choice for this type installation.

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Your quality source for thousands of "roughing in" items!

The quality of a product is known by the men who use and recommend it, and APPLETON outlet boxes, switch boxes, conduit fittings, plus thousands of "roughing in" items are the standard choice of progressive electrical contractors from coast to coast. The economies resulting from single-source ordering are well known to these profit-minded businessmen. APPLETON'S uniform high quality and cost-saving features cut installation time and assure electrical contractor users one trouble-free job after another.

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Published for electrical contractors, industrial electricians, engineers, consultants, inspectors and motor shops. Covering engineering, installation, repair, maintenance and management, in the field of electrical construction and maintenance.

57th Year OCTOBER • 1957

Sidelights 5

Washington Report 7

New School Alarms, *An Editorial* 103

APPLIED LIGHTING Layout and Design Data 105

Roundup of technical data and practical procedures for use in the design of efficient and high quality lighting systems.

- Lighting Problem Analysis 106
- How Much Light 108
- Lighting Quality 109
- Light Control 112
- Light Sources 114
- Lighting Systems 116
- Lighting Modules 118
- Luminaires 119
- Equipment Layouts 120
- Lighting Calculations 122
- Supplementary Lighting 125
- Lighting Economics 126
- Wiring for Lighting 128
- Lighting Components 130

Electrical Systems for New CGI Office Building 133

By W. T. STUART—Suburban Hartford, Conn., headquarters of Connecticut General Life Insurance Co., is served by duplicate primaries, radial selective high voltage distribution, 277/480-volt power and light.

MORE

OCTOBER • 1957 *continued*

10,000 Watts of Residential Lighting 138

By W. J. MARTENS—Residential lighting installed in a new dwelling in Des Moines features a combination of recessed and surface fixtures, dimming on living room lights, and remote control switching.

Voltage Drop Charts for Aluminum Conductors 140

By G. H. REDDEN—New graphic method of determining aluminum wire voltage drop for specific circuit conditions. Projections on a single chart give percentage-drop answers.

Estimating Forum—IV 146

By RAY ASHLEY—Operating costs—Is a job expense list necessary?

Common Code Problem 148

By B. A. McDONALD—Circuit breaker as disconnect.

Motor Shops 152

Parts selection for small motor jobs; spare parts facilitate armature winding; envelope rack used as a wire holder.

Protect Your Future—Corporation 164

By GEORGE KOSSOY—Second in a series of three articles for electrical contractors recommending security measures to provide for the continuity of the firm and the preservation of assets.

Reader Service 169

Product news announcements; catalogs and bulletins.

Reader's Quiz 210

Questions and answers on phase addition; outlet box mounting, transformer sizing; reversing circuit.

Questions on the Code 219

Answers to code questions including service disconnects; split electric range; lighting fixtures for a garage.

Practical Methods 244

Lighting, with air conditioning; continuous ceiling lighting; electric drill notches wood joists and studs.

In the News 255

Dates Ahead 281

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Sidelights

LIGHTING CONTESTANTS–If you have entered the 1957 International Lighting Competition, and have not yet completed and mailed in your Entry, this is a reminder that the contest closes October 25. Your Entry should be mailed on or before midnight of that date. Why not complete it and get it in the mail at once? Don't take a chance on losing out on the prize money. Remember, there are 120 prizes to be given away. Be sure to take advantage of this opportunity to win a cash prize, plus local and national recognition.

WIRING DESIGN–The new home office building of the Connecticut General Life Insurance Co. in suburban Hartford, Conn., is attracting international interest as an outstanding achievement in modern American architecture and the effective use of modern construction materials and methods. Behind the walls of glass and metal are parallel achievements in modern electrical and mechanical construction, installation and application.

Twin electric service facilities with primary selective distribution and secondary ties assure electric continuity. Emergency power generation at distribution voltage (4,160) is also provided to carry up to 15% of full demand load of this building continuously. A variety of lighting methods are employed including a custom designed, modular, open baffle ceiling. A description of the work, "Electrical Systems for new CGI Office Building" begins on page 133.

CIRCUIT BREAKERS–Use, in motor branch circuits, of manually operated circuit breakers as disconnects, as overcurrent protection, as controllers or combinations often inspire some searching questions about the strict application of the code requirements as they pertain to the various elements of the motor circuit.

In one of his popular "Common Code Problems" discussions, consulting editor B. A. McDonald takes up the application of the circuit breaker in the motor branch circuit with reference to the applicable Code provisions. "Circuit Breaker as Disconnect" begins on page 148.

10 KW OF HOME LIGHTING–A residential electrical system planned and installed by Brown and Weston, electrical contractors of Des Moines, Iowa, serves 10,000 watts of lighting. The company's efforts in the field of modern lighting application to residences is attracting statewide attention. With expert planning and performance, they are selling modern lighting and wiring installation to home builders that reach far beyond minimum practice and build the electrical system into a major feature of the new home.

The story of the 10 kw lighting installation begins on page 138, and is the first to appear under the by-line of our new assistant editor, W. J. "Bill" Martens. He joined the editorial staff of Electrical Construction and Maintenance in June of this year. After a training period at our New York headquarters, he has been assigned to the Chicago office, where he will work under the able guidance of Middlewest Editor, August Eckel. With six years of practical experience in all phases of the electrical contracting business, Martens is particularly well equipped to report and interpret significant developments of special interest to our readers.

WELL DONE–During the summer, we invite an engineering college student to join our editorial staff. He makes a useful extra hand for us, and he has an opportunity to study technical publishing from the inside. This summer we were particularly fortunate in having Ned Benhaim, between his fourth and fifth year in electrical engineering at Cornell, as our student editor. He quickly demonstrated exceptional ability and handled some exacting assignments with professional skill. We wish him every success in his studies and his future career.

ELECTRICAL MATERIALS COST INDEX
BASE LINE IS 1000 AND REPRESENTS COSTS OF A TYPICAL ASSORTMENT OF MATERIALS FOR A SELECTED JOB AS OF NOVEMBER 1, 1951. THE INDEX POINTS REPRESENT THE VARIATION OF THESE SAME MATERIAL COSTS AS OF THE FIRST OF EACH MONTH.
JAN FEB MAR APR MAY JUNE JULY AUG SEPT OCT NOV DEC
1150 1140 1130 1120 1110 1100 1090 1080 1070 1060 1050 1040 1030 1020 1010 1000 (BASE) 990
1957
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1956
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LE Series (Class I, Groups C and D)
60 to 500 Watts
Choice of body and reflector styles

EXPLOSION-PROOF Floodlights
FEA Series 150 to 300 Watts

DUST-TIGHT
DE Series (Class II, Groups E, F and G and Class III)
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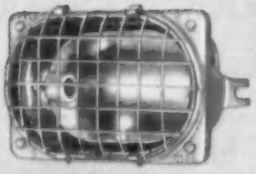
Choice of body and reflector styles

VAPOR-TIGHT
DO Series 10 watt signal or pilot lights
BO Series 50 to 500 watts
Choice of body and reflector styles

FLUSH VAPOR-TIGHT
Type 1570 Pit and subway lights
100 and 200 watts



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Washington Report

Business activity holds at a high level, but the rate of increase is declining. For example, capital spending for new plants and equipment is losing steam, as many industrial firms plan cuts in plant outlays for 1958. Business firms, as well as consumers, are taking more time to pay bills. Industrial production is holding steady at 144% of the 1947-49 average. And while man-days lost due to strikes are down for 1957, cutbacks in Defense spending and production of many products in excess of demand have resulted in release of some employees, and temporary layoffs.

Encouraging signs also show up. For example, personal income continues to climb. Retail sales are up about 5% above last year. Auto production this year is now expected to equal last year's rate. Employment remains high. And steel production, although running at little more than 80% of capacity, will still just about match the 1956 production of 117 million tons.

New construction expenditures set another record in August, with a $4.6 billion total. This was 4% above July, and 3% above a year earlier. Privately-financed work declined 1% from a year earlier to $3.1 billion, while publicly-financed work rose 10% above a year earlier to $1.5 billion. New construction for the first eight months totaled $30.5 billion, for an increase of 2% from the like 1956 period.

Construction in July was slowed down due to cement shortages brought about by a five weeks strike. The total was still $4.0 billion, about equal to July total a year earlier. Highway construction was especially hard hit, Commerce and Labor Depts. reported.

Capital spending in the fourth quarter for new plants and equipment will drop slightly, to an annual rate of $37.2 billion, from the previous annual rate of $37.9 billion set in the first half year period, according to Government estimates. But it is still expected that spending will hit a new record this year, some 6% above last year's total of $35.7 billion.

New homebuilding topped the one million annual rate in August, for first time this year, when housing starts totaled 95,000. Private financing accounted for 92,600, as compared with 90,200 in July. Total public and private unit starts for first eight months of this year declined 11% from similar 1956 period, and totaled 700,500. Lower down payments and higher interest rate ceilings were credited with aiding the upturn, but some industry spokesmen attributed the change in pace to efforts of builders to produce better homes without increasing prices.

Employment hit a record 67.2 million in mid-July, up about 500,000 from a year earlier. In August the total dropped about 800,000, to 66.4 million, which represented a decline from the 66.8 million employed in August 1956.

Personal income was at annual rate of $347.3 billion in August, Dept. of Commerce reported. That is an increase of $18 billion for the year, and up a little more than a billion from July.

Retail sales to consumers in August was nearly $17.7 billion, a record for the month, and exceeded only by December sales for any month. Monthly gains in retail sales over year-earlier sales ran from 3% to 5%. Increases in July and August were up 7%.

Living costs rose again in August, twelfth month in a row to show a rise. Record food prices were mainly responsible for the gain.

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1-POLE
15-50 Amps

2-POLE
15-70 Amps

3-POLE
15-50 Amps

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There's just ONE ARRANGEMENT. 2-pole breakers go anywhere on the bus assembly. You don't need a wiring diagram to tell you where to put them. And there's no limit on the number of 2-pole breakers you can use. The same applies on 3-pole breakers for 3-phase jobs.

ONE FULL-SIZE BREAKER!

Each pole in its own case and all poles are the same size. Double-pole breakers take only two single-pole spaces—3-pole breakers only three. No more.

LESS MONEY TIED UP IN STOCK!

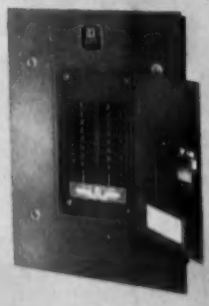
Only one kind of breaker for all load centers—*no duplicate stocks.* The same breaker for panelboards —*no duplicate stocks.* This is true for all the ampere ratings in 1-pole, 2-pole and 3-pole breakers. Incidentally, the 3-pole breaker comes in mighty handy for 3-phase air-conditioning loads, because it fits on the same bus. No separate box needed.

AND HERE'S THE BIG PAYOFF —THERE'S JUST ONE QUALITY!

There's no sacrifice in quality or features to save space. All **QO** breakers, including single-pole, are quick-make, quick-break, temperature corrected and have sensitive magnetic trip to protect against "flash" shorts. Judged on any basis of comparison, the **QO** is the finest breaker ever built!

QO ...*THE "NO CALL BACK" BREAKER*

NAME THE JOB AND THE QO CAN DO IT—*EXACTLY*



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1-Phase or 3-Phase
Lugs or Main Breaker
14″ or 20″ wide boxes
4″ or 5¾″ deep

Column Panelboards
1-Phase or 3-Phase
Lugs or Main Breaker
with 1, 2 and 3-pole branches

Load Centers
1-Phase or 3-Phase
2 to 42 circuits
Lugs or Main Disconnect
Service Entrance—Split bus type

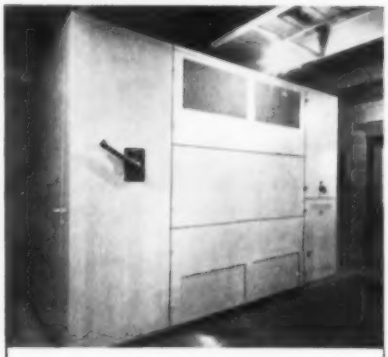
Raintight Enclosures
2 through 30 circuits

Nation's most modern air terminal served by power from Wagner Transformers!

The "Spirit of St. Louis" is reborn in the city's newest symbol of the air age—the dramatic new terminal at Lambert-St. Louis Municipal Airport. Built at a cost of $7,728,000 and dedicated in 1956, it's the most modern in the nation.

Electric power for this terminal is distributed by five secondary unit substations, rated from 300 to 1500 kva. These were manufactured by Nelson Electric Company and equipped with safe, dependable Wagner dry-type Transformers. Wagner dry-type Transformers are carefully engineered to provide an uninterrupted flow of power—built to stand up under rigorous 24 hours a day schedules. Wagner pioneered in the development of dry-type load center transformers, and the Wagner design is known for its great electrical stamina and mechanical strength.

Wagner dry-type unit substation transformers can answer your power needs just as they do at Lambert-St. Louis Municipal Airport. They are "Predesigned"—coordinated with the specifications of unit substation builders to save you job engineering, time, and cost. Consult the nearest of our 32 branch offices, or write for Bulletins TU-205 and TU-214 for full information.



This is the Nelson main substation at the St. Louis Airport. It is equipped with a 1500 kva Wagner Dry-Type Transformer.

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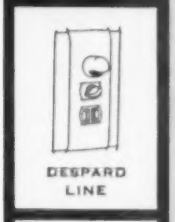
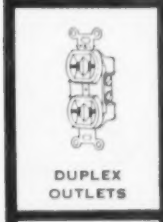

DESPARD LINE

GROUNDING OUTLETS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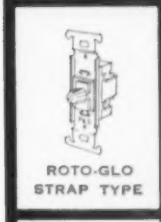
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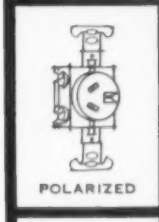
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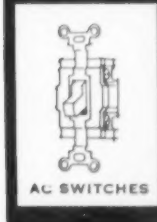
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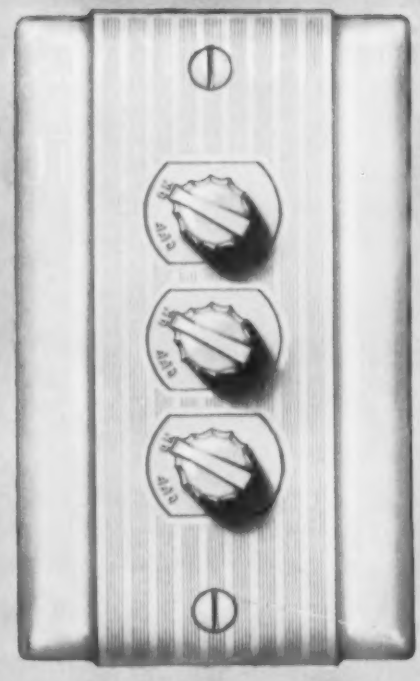
a complete line of wiring devices of the Highest Character



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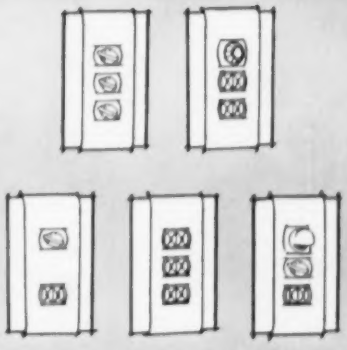
Everyone likes a light switch that can be seen in the dark. And Roto-Glo—with its soft, luminous glow—is always visible. Quiet, too—a quarter-turn and lights go on or off without a sound. Roto-Glo is truly in tune with modern interiors.

Compact design allows the use of up to three switches in one ordinary sized ivory, brown, chrome or other attractive wall plate. Long life is assured by large silver alloy contacts. Can be used to full current rating on tungsten filament and fluorescent (inductive) loads, and on motors when full load current is not more than 80% of switch rating.



For information on Roto-Glo and other high standard P&S wiring devices, write Dept. ECM-31.

P&S

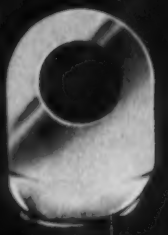
PASS & SEYMOUR, INC.

SYRACUSE 9, NEW YORK

60 E. 42nd St., New York 17, N. Y. 1440 N. Pulaski Rd., Chicago 51, Ill.
In Canada: Renfrew Elec. & Refrig. Co., Ltd., Renfrew, Ontario

MAKE THE COMPLETE JOB COMPLETELY P&S

AMP COMPRESSION for the



ALL TERMINALS SHOWN ACTUAL SIZE

SOLISTRAND®
22-600 MCM AWG

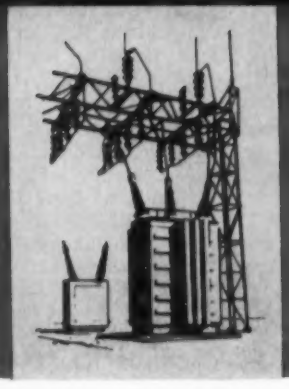
Ampli-Bond®
8-4/0 AWG

DIAMOND GRIP
26-10 AWG

PRE-INSULATED DIAMOND GRIP
26-10 AWG

SOLISTRAND Butt and Parallel Connectors for innercoil connection to leads. SOLISTRAND Terminals on outside leads of transformers.

PRE-INSULATED DIAMOND GRIP and DIAMOND GRIP Terminals and Connectors for switchgear panel wiring in generator plants and sub-stations.



SOLISTRAND and AMPLI-BOND Terminals and Connectors for construction and maintenance of generator plants and sub-stations.

PRE-INSULATED DIAMOND GRIP and SOLISTRAND Terminals and Connectors for street and traffic light installation and maintenance.

TERMINAL PRODUCTS UTILITY INDUSTRY...

AMP's diversified lines of terminal and connector products . . . and matched precision-engineered application tooling . . . have been part of the utility industry's components story, in many ways, for many years. These products have been designed for the exacting requirements of the electrical industry in general, and a predominant number of original equipment items depend on the AMP method of termination and connection for service reliability.

AMP's diversified lines of terminal and connector products include:

SOLISTRAND®—of one-piece construction, for application to stranded, solid or irregularly shaped conductors.

DIAMOND GRIP—non-insulated, but having metallic sheath to provide full circumferential support to cable. Excellent for applications where resistance to vibration is a factor.

Ampli-BOND®—provide full insulation support for large wire sizes. They are bonded and reinforced to prevent relaxation of cable support.

PRE-INSULATED DIAMOND GRIP—insulated with tough plastic that won't come off . . . it's bonded. Affords optimum performance under vibration.

Some typical applications of these A-MP products are shown below.

AMP's continuing programs of research and development are increasing the potential of newer products to speed operations, reduce costs, and improve reliability for all phases of utility activity.

A-MP products, when required for maintenance and repair needs, are available in the U. S. A. through American Pamcor Inc. api

For additional information write to:

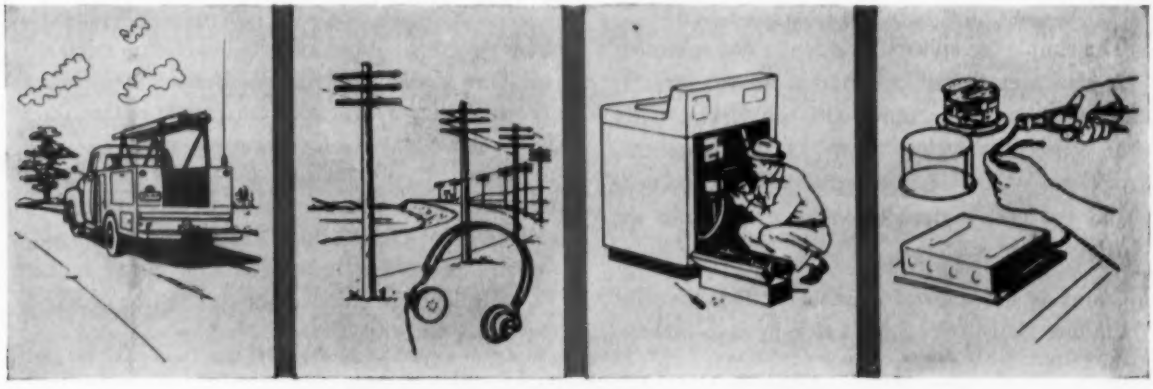
AMP INCORPORATED

General Offices:

7337 Eisenhower Boulevard, Harrisburg, Pa.

Wholly Owned Subsidiaries: Aircraft-Marine Products of Canada, Ltd., Toronto, Canada • Aircraft-Marine Products (Great Britain) Ltd., London, England • Societe AMP de France, Le Pre St. Gervais, Seine, France • AMP—Holland N.V. 's-Hertogenbosch, Holland

Distributor in Japan: Oriental Terminal Products Co., Ltd., Tokyo, Japan

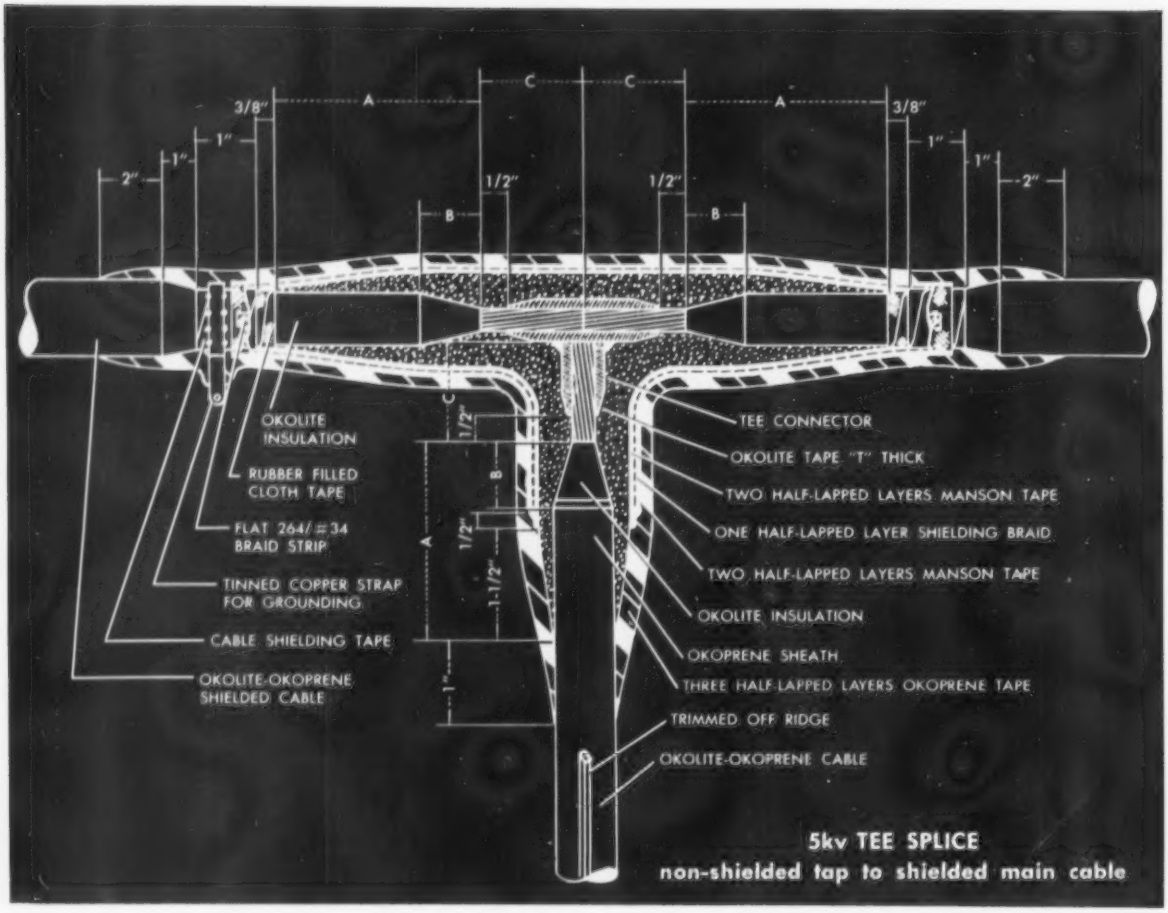


PRE-INSULATED DIAMOND GRIP, DIAMOND GRIP, and SOLISTRAND types find extensive usage in truck and car fleet maintenance.

PRE-INSULATED DIAMOND GRIP Terminals and Connectors for communications equipment.

PRE-INSULATED DIAMOND GRIP, DIAMOND GRIP and SOLISTRAND types for appliance repairs.

PRE-INSULATED DIAMOND GRIP, DIAMOND GRIP and SOLISTRAND types for meter repairs.



The "simple" tee splice . . .

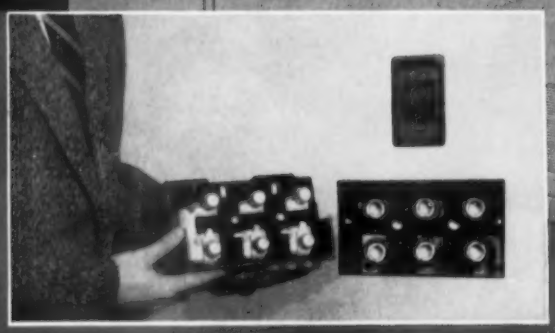
The simple tee splice . . . is really not so simple. A glance at the splice diagram above certainly shows this. Don't gamble with the dependability of your cable system by neglecting its splicing or terminating. Use the correct splicing methods and the best materials available to insure the safety of the system.

Complete splicing and terminating diagrams, like the one above, along with step-by-step instructions covering rubber-insulated cables up to 5000 volts are available in Okonite Bulletin EC-1085. These splicing instructions are a result of Okonite insulation research—the same research that has developed the industry's best-known splicing materials . . . Manson friction tape, Okonite rubber tape, Okolite high voltage rubber tape, and Okoprene weather-resistant neoprene tape. For full details, contact your distributor or The Okonite Company, Passaic, N. J.

Available through authorized distributors only

OKONITE splicing tapes

4326



Mounted in molded cases, the Amp-traps are accessible from the front of the substation for speedy replacement. Four frame sizes of the 100,000 RMS ampere IC rated "Cordon" current-limiting breakers are now available—100, 225, 400 and 600 amps; 600 volts AC; 250 volts DC.

BullDog Unit Substations provide greater protection against high short circuits with new "Cordon" current-limiting breakers

Here's extra protection for your customers' equipment! Fault currents of 100,000 RMS amperes can destroy equipment by arcing, burning and magnetic distortion. The new BullDog unit substation with "Cordon"* breakers provides this necessary protection. "Cordon" breakers bring real savings, too, since they can be used where more costly air breakers were once required. They combine the advantages of standard thermal magnetic breakers with current limiting characteristics of Amp-traps** . . . limit damaging fault currents to low values.

Let a BullDog field engineer give you all the facts about unit substations and complete BullDog electrical distribution systems today.

© BEPCO

IF IT'S NEW . . . IF IT'S DIFFERENT . . . IF IT'S BETTER . . . IT'S

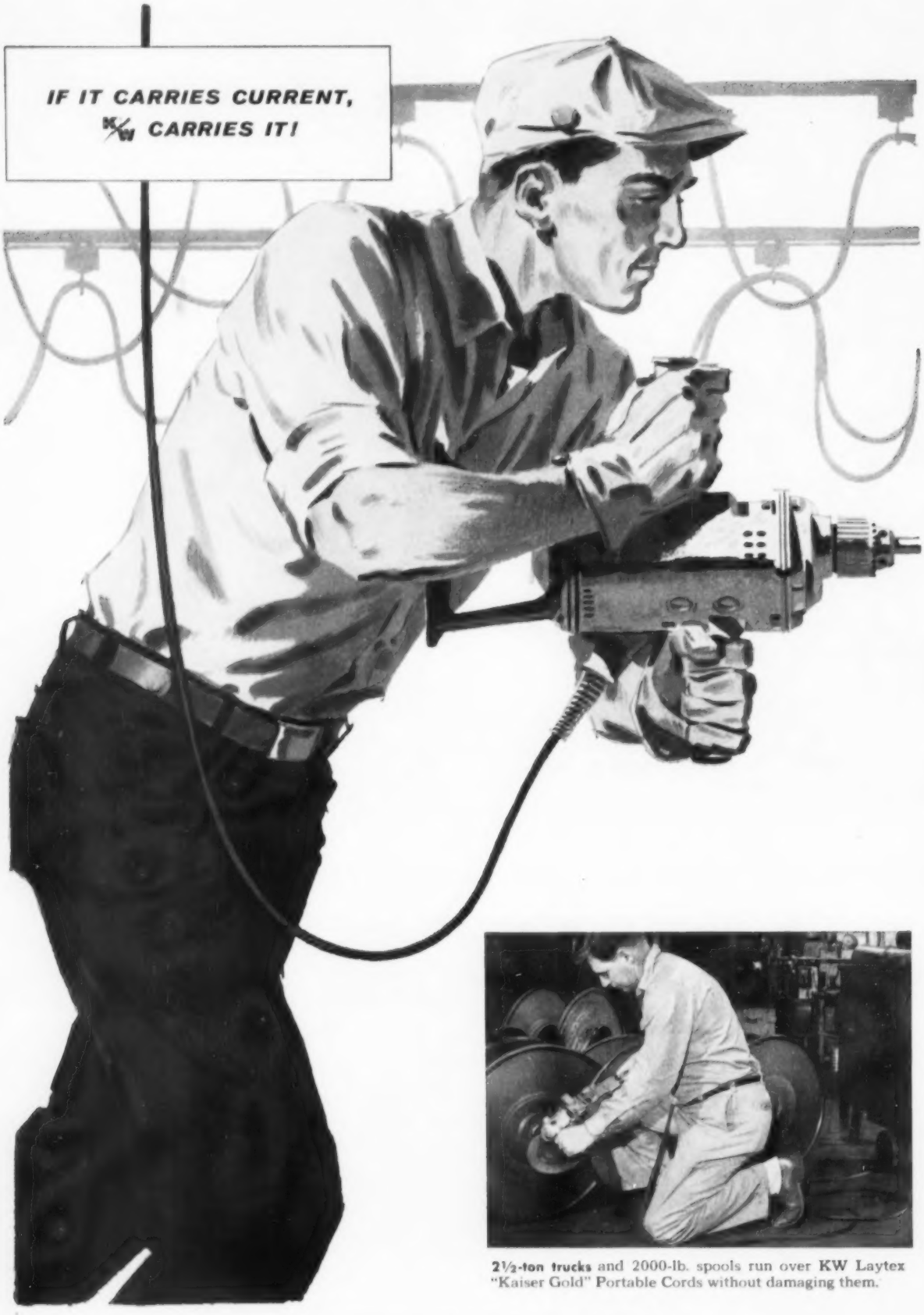
BULLDOG

ELECTRIC PRODUCTS COMPANY

A DIVISION OF I-T-E CIRCUIT BREAKER COMPANY

BullDog Electric Products Company, Detroit 32, Michigan • A Division of I-T-E Circuit Breaker Company • *Export Division:* 13 East 40th St., New York 16, N.Y. *In Canada:* BullDog Electric Products Co. (Canada), Limited, 80 Clayson Rd., Toronto 15, Ont.

*Trade-mark registered by I-T-E Circuit Breaker Company **Trade-mark registered by Chase-Shawmut Company



2½-ton trucks and 2000-lb. spools run over **KW** Laytex "Kaiser Gold" Portable Cords without damaging them.

CASH-SAVING FACT

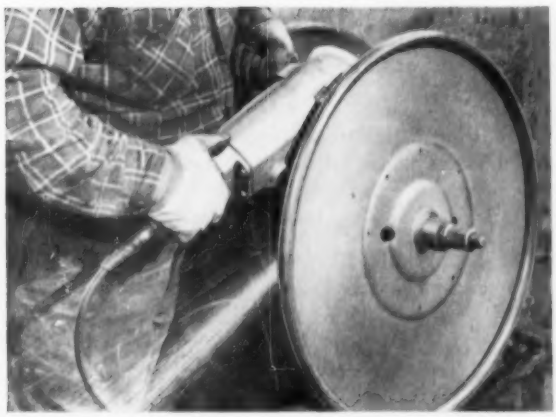
MORE THAN 12,000 TESTS CONDUCTED OVER A THREE YEAR PERIOD PROVE KW PORTABLE CORDS GIVE THREE TIMES LONGER LIFE THAN THE AVERAGE OF MOLDED CORDS OF OTHER MANUFACTURERS! THEY'RE WELL WORTH THE FEW EXTRA PENNIES YOU PAY PER FOOT. CALL YOUR KW DISTRIBUTOR OR CONTACT THE NEAREST SALES OFFICE OF...

Kaiser Aluminum

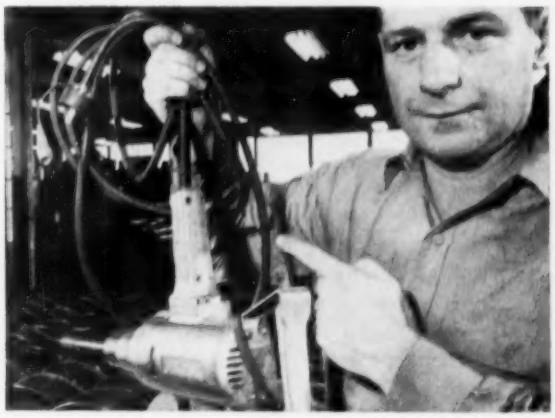
IF IT CARRIES CURRENT, KW CARRIES IT!

Kaiser Aluminum & Chemical Sales, Inc., *Executive Office*, Kaiser Bldg., Oakland 12, California; *General Sales Office*, Palmolive Bldg., Chicago 11, Illinois.

LIVE BETTER ELECTRICALLY



Sharp bits of hot steel in a grinding operation slash at KW Laytex "Kaiser Gold" Portable Cords—without damage.



Workers have a habit of grabbing handtools by their electrical cords. This tool weighs 25 lbs., yet the KW "Kaiser Gold" Cords have always held fast.

Mr. Groom (left) discussing concealed wiring installation with Edward A. Smith of The Pacific Telephone & Telegraph Company

"Concealed telephone wiring is a profitable investment for builders"

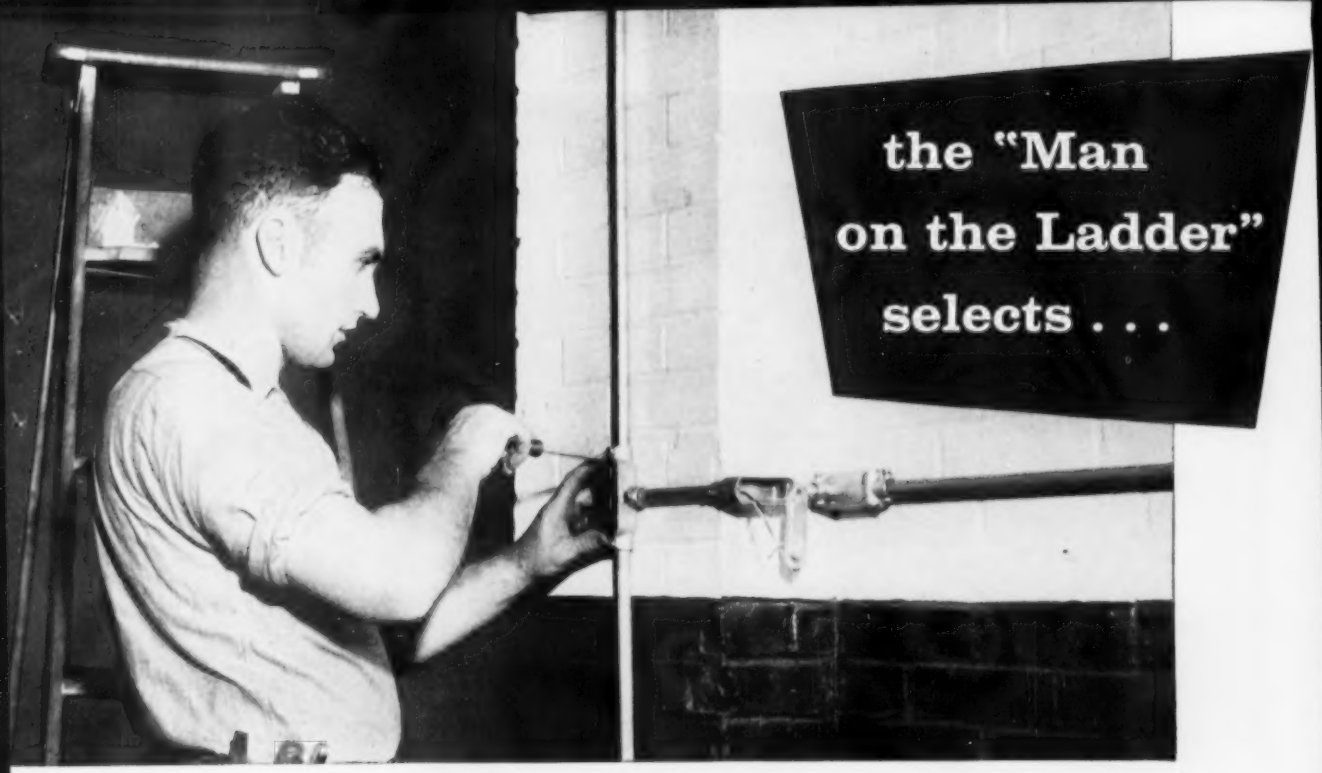
— says Glen L. Groom, Builder, of Chabot Park, Oakland, Cal.

"I build houses by the dozens," says Mr. Groom, "as many another builder does. Sometimes I have as many as a hundred going up at once. And in every one I invest in concealed telephone wiring just as I invest in concealed electrical wiring and other built-in facilities that modern home-buyers look for and want.

"Concealed telephone wiring is a profitable investment for me. It's a salable item itself but, more important, it helps me sell my homes because it means added convenience, and preserves the finished beauty of the rooms. In a business where you're constantly trying to second-guess Mrs. Smith and Mrs. Jones, concealed telephone wiring is a helpful sales feature."

Your nearest Bell Telephone business office will help you with concealed wiring plans. For details on home telephone wiring, see Sweet's Light Construction File, 8i/Be. For commercial installations, Sweet's Architectural File, 32a/Be.

Working together to bring people together
BELL TELEPHONE SYSTEM



Killark Speedolet Fittings

for their *SPEED* and *EASE OF INSTALLATION* with thinwall conduit.

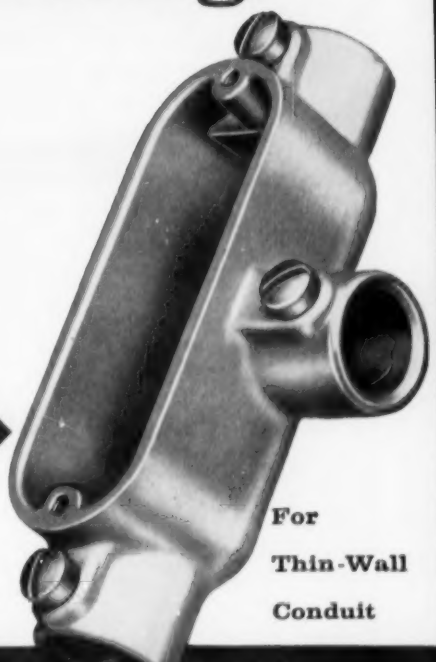
"I'm sold on Killark's new line of SPEEDOLETS . . . they make the fastest, neatest installations I've ever seen.

"Now I can go up the ladder with no more than a screwdriver in my hands. All I have to do is slip the fitting over the thinwall conduit, tighten a set screw — the job's finished! No wrench to use, no small parts to handle.

"Speedolets save dollars and hours on every installation! No threads or special clamps are needed. Slip into place, tighten set screws. They cost less than other type fittings — and save labor cost on installation."

ELECTROLET KILLARK SPEEDOLET

Short on installation time, but long on durability! Speedolets are die cast of the same special aluminum alloy that has made Killark fittings famous for years. They'll last and last . . . because aluminum never rusts or corrodes. Write for Speedolet Literature.



For Thin-Wall Conduit

Killark

K KILLARK ST. LOUIS

ELECTRIC MANUFACTURING COMPANY

Vandeventer and Easton Aves. St. Louis 13, Missouri

SALES OFFICES and WAREHOUSE STOCKS	Atlanta	69 Mills St., N. W.	Dallas	1901 Griffin St.	Philadelphia	2014 Chancellor St.
	Boston	49-51 D St.	Denver	1073 Galapago	Pittsburgh	4830 McKnight Road
	Buffalo	278 Johnson St.	Detroit	8319 Mack Ave.	San Francisco	714 Harrison St.
	Chicago	1528 West Adams St.	Los Angeles	412 Seaton St.	Seattle	4130 First Ave., So.
	Cincinnati	1031 Meta Dr.				
SALES OFFICES	Baltimore	11 W. 25th St.	Kansas City, Mo.	616 W. 26th St.	New York	600 W. 181st St.
	Columbus	390 McCoy St.	Minneapolis	826 Andrus Bldg.		

Sales Offices and Warehouse Stocks throughout Canada

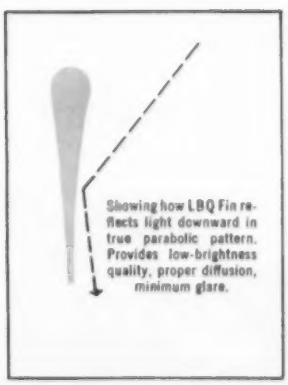
It's here...

It's new...

It's the

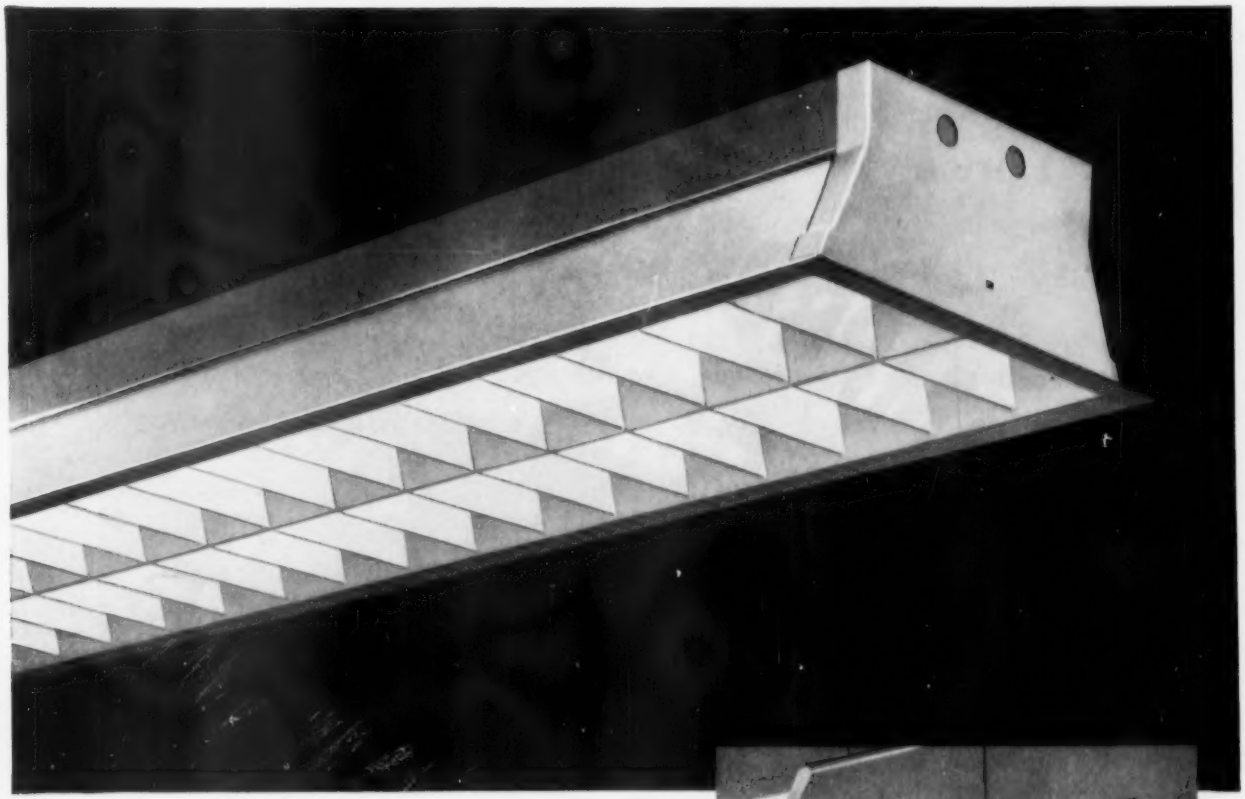
Curtis Troffer

with **L.B.Q.***


Showing how LBQ Fin reflects light downward in true parabolic pattern. Provides low-brightness quality, proper diffusion, minimum glare.

See the LBQ Troffer demonstrated in booth #145 at the NECA convention, in Cincinnati, November 12-15.

Curtis Eye Comfort Alzak Aluminum Troffer with LBQ Louver Fin. Snap-on yoke and toggle bolts for easy application to any ceiling: plaster, acoustical tile, or inverted T-grid. New shallow depth . . . maximum recessing space required, 6½".



Exclusive with Curtis—LBQ Louver Fin with*
**Low-Brightness Quality—assures rigid, rugged strength*

The end result desired in lighting is high level illumination with maximum visual comfort. Both are achieved with the new Eye Comfort®, Alzak† Aluminum Troffer, by Curtis. This new troffer features a completely unique and exclusive design in the extruded LBQ Louver Fin—an original Curtis development. The heaviest Alzak Aluminum Fin yet devised provides absolute rigidity and permanent strength—longest life, ever. V-bar and fin of the Curtis Troffer produce a parabolic pattern in both directions. With the LBQ Louver, *only Curtis has a true parabolic-shaped fin.* Result: High output . . . with low-brightness quality . . . from all critical viewing angles. There's proper diffusion, comfortable illumination, wherever light is cast. Reflected glare is minimized. Be one of the first to see how the new Curtis Eye Comfort Troffer, with extruded LBQ Louver Fin, can solve lighting problems better in offices, schools, stores, institutions—all commercial buildings. Write today for a demonstration by a Curtis Visioneer (vision engineer) in planned lighting.

CURTIS

CURTIS LIGHTING, INC.
6135 W. 65th St., Chicago 38, Illinois
In Canada: 195 Wicksteed Avenue, Toronto 17, Canada
Visioneers in Planned Lighting©

Extruded LBQ Louver Fins rigidly lock into heavy gauge Alzak Aluminum V-Bar. Louver quickly snaps into place—no latches or tools required. Unbroken lines of light, with no intervening light obstructions between end plates.

This is another example of Curtis Planned Lighting . . . high level illumination plus complete visual comfort. Installation: Third National Bank, Rockford, Illinois.

® TM Curtis Lighting, Inc.
† A Proprietary Term of the Aluminum Co. of America
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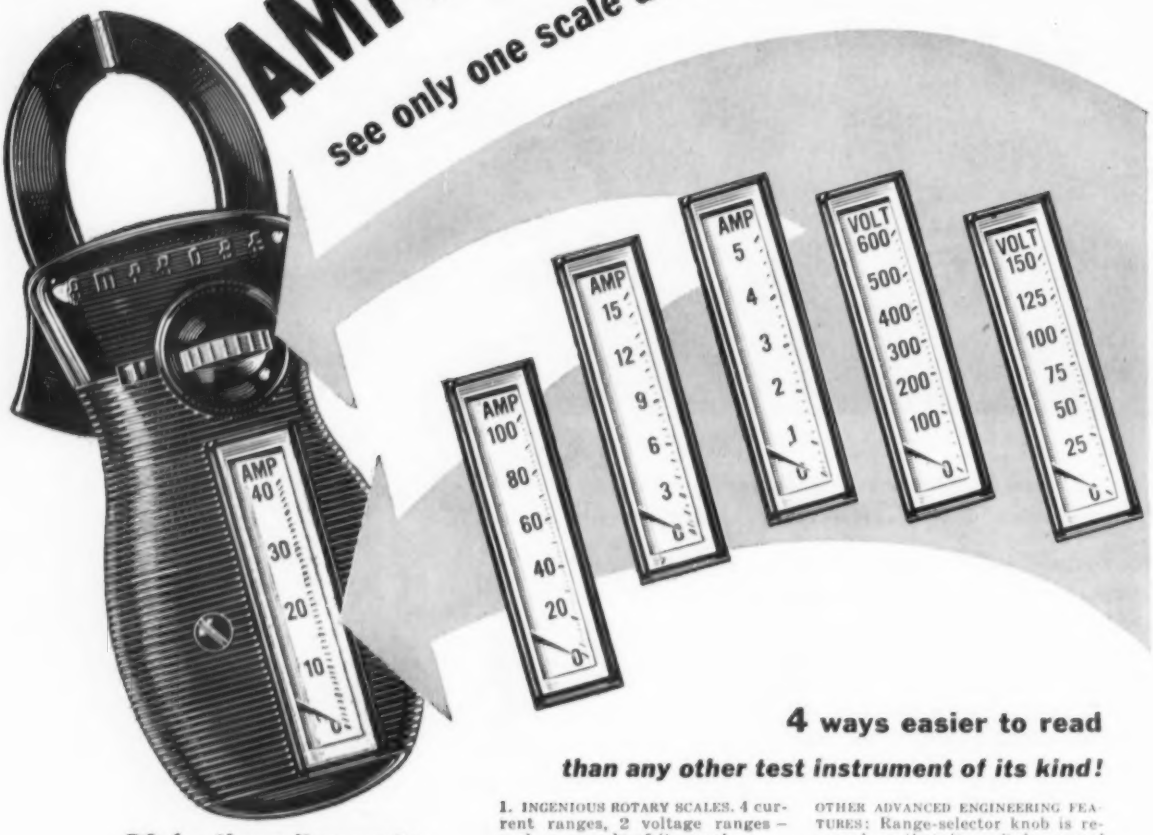
More features, at your call at the lowest price of all

AMPROBE RS-1 only $39.85

see only one scale at a time!



RS-1 — the volt-ammeter with the most-used ranges

There's one for every job and every budget.

The new RS-1 is one of the 14 AMPROBE models priced from $19.85 to $67.50.

® *

4 ways easier to read

than any other test instrument of its kind!

1. INGENIOUS ROTARY SCALES. 4 current ranges, 2 voltage ranges — each on a scale of its own!

2. ONE HAND OPERATION! Range selector knob is next to your thumb.

3. NEW MAGNIFIED DIAL . . . LONGER SCALE LENGTH. Greater visibility, greater accuracy, than ever before.

4. POINTER-LOCK "FREEZES" POINTER AT READING. Use the RS-1 any place your hand can reach. Needle can be locked in place so that you may read it away from conductor.

OTHER ADVANCED ENGINEERING FEATURES: Range-selector knob is recessed so that it can't be moved accidentally. Simple bayonet leads lock in at bottom for quick connecting. Impact-proof case with non-slip ribbing. Advance printed circuit construction. Shielded core magnetic movement. Leather carrying case can be worn on your belt.

Amprobe, a division of Pyramid Instrument Corp., Lynbrook, New York, manufacturers of famous REMCON simplified low-voltage Hi-Fashion switching devices.

don't guess at it; AMPROBE IT!

CRESCENT

OVER 70 YEARS EXPERIENCE

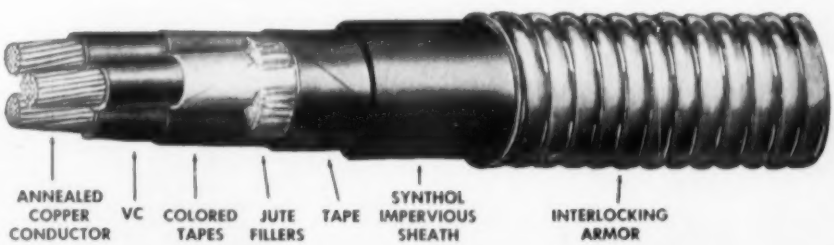
INTERLOCKED ARMOR POWER CABLE

Can Be Easily and Quickly Installed
. . . Saving Both Time and Money

Crescent Interlocked Armor Cable with ALUMINUM or GALVANIZED STEEL ARMOR provides a flexible metal-enclosed method of wiring for power. Speed and economy of installation are the principal advantages of these cables since they can be placed on easly hung racks or attached to building surfaces.

Maximum current carrying capacity is secured by the use of the varnished cambric insulation. For outdoor or damp location installation, it is furnished with SYNTHOL IMPERVIOUS SHEATH between the insulated conductors and armor, as illustrated below.

INTERLOCKED ARMOR CABLE
WITH IMPERVIOUS JACKET
Three Conductor-VARNISHED CAMBRIC INSULATED-O-5000 Volts



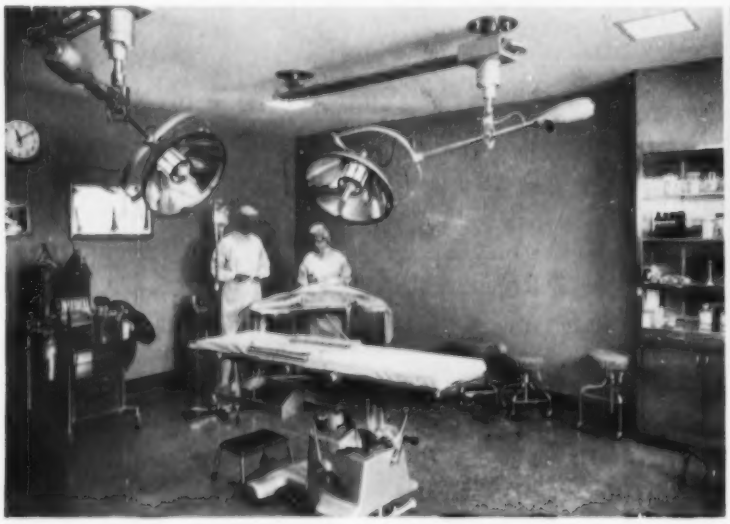
The Varnished Cambric insulated conductors are thoroughly protected by the Impervious Sheath of tough thermoplastic which is highly resistant to moisture, alkalies, acids and oils. This cable shows attractive savings when strung from messenger cable or in troughs outdoors as between buildings.

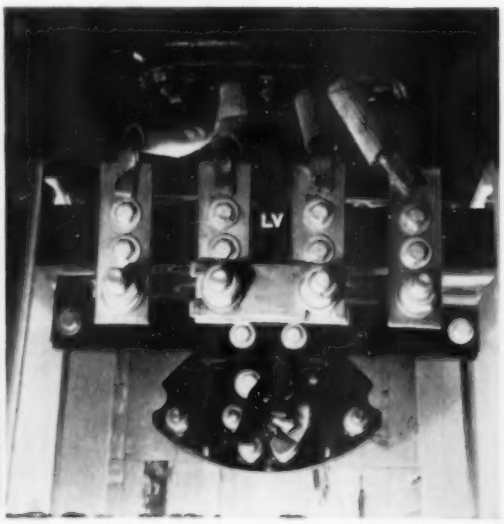
WRITE FOR BULLETIN

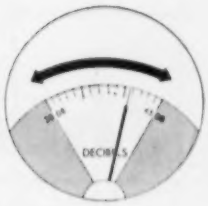
CRESCENT INSULATED WIRE & CABLE CO.

TRENTON 5, NEW JERSEY

Hacienda-like appearance of St. Luke's Hospital belies the modern surgical miracles that are performed within . . . miracles performed in an aura of silence . . . a silence which DS-3 transformers help to maintain.







NEW single-phase dry-type transformer

INSTALLED IN HOSPITAL GIVES NO DECIBEL READING . . . EVEN WITH METER ON TRANSFORMER SURFACE!

Absolute quiet must be maintained in the surgical areas of a hospital. The Westinghouse DS-3 transformers installed next to the surgical X-ray rooms of the new Louis Galland Memorial Wing of St. Luke's Hospital, Phoenix, Arizona, fulfill these standards of silence. So quietly do they perform that with meter scale at 40 db, no reading whatever could be taken, even when the meter was placed on the surface of the transformer.

Sound absorption. A new mechanical vibration dampening system floats core and coils independent of base, case and connecting conduit. Even with rigid conduit, no noise is transmitted to mounting equipment and conduit.

Smaller, more efficient. Two Westinghouse exclusives—inorganic Silclad insulation and grain-oriented Hipersil® steel cores—reduce size up to 11%, weight up to 32%, as compared with previous 80°C units.

Long, trouble-free service life. Case temperatures are no higher than for 80°C transformers, are lower than Underwriters' standards. Reduced heat offers additional savings in longer component life, greater overload capacity. This is especially important in high ambient areas, such as the Phoenix, Arizona, location of St. Luke's Hospital.

For complete information on the DS-3 transformer, call your local Westinghouse salesman or distributor, or write Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

J-70809

YOU CAN BE SURE...IF IT'S Westinghouse

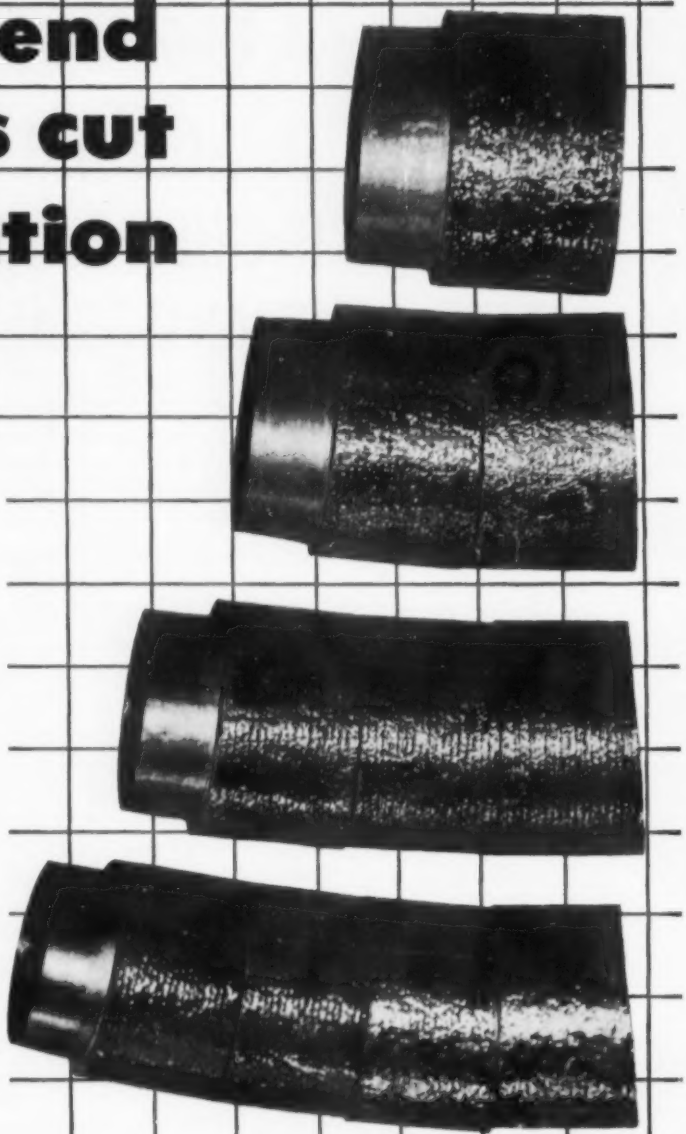
If your plant is a victim of undervoltage, it's time to POWER-UP. Ask your Westinghouse representative or your utility power sales engineer for specific recommendations to fit your problem.

Left—Although this DS-3 transformer is located only a few short feet away, perfect operating room quiet is maintained at all times.

Center—Tap changer permits secondary voltage correction in seconds—a twist of the wrist adjusts secondary voltage for changing load conditions—another exclusive from Westinghouse.

Right—Rigid conduit can now be used with DS-3 transformers; the vibration dampening system completely eliminates noise transmission to conduit and mounting equipment. This transformer shows no rise in sound level, even when decibel meter is placed on top surface.

These bend sections cut installation costs



Orangeburg 5° Bend Sections are the "on-the-job" answer to special bend problems. They get over, under or around those unforeseen obstructions . . . and do it easily and economically.

Crossovers . . . transformations . . . offsets . . . can be made in the field by joining sections together to obtain the desired direction change. No costly delays . . . no special bends needed.

Orangeburg 5° Bend Sections* are another reason why Orangeburg Fibre Conduit is the ideal protective raceway for underground electrical cables.

Distributed by Graybar Electric Company and General Electric Supply Company Branches and stocks in principal cities.

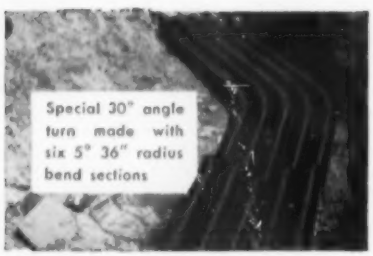
Write Dept. EC-107 for Bulletin S.E.C.

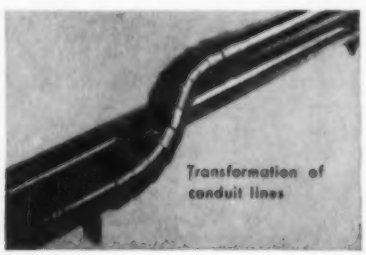
**Made for Orangeburg Standard Conduit only.*

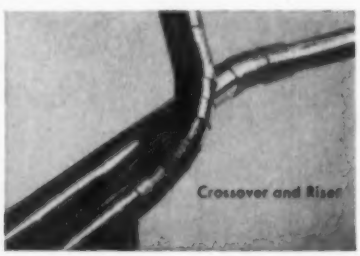
ORANGEBURG MANUFACTURING CO., INC.
Orangeburg, N. Y. Newark, Calif.

ORANGEBURG®

FIBRE CONDUIT PROLONGS CABLE LIFE



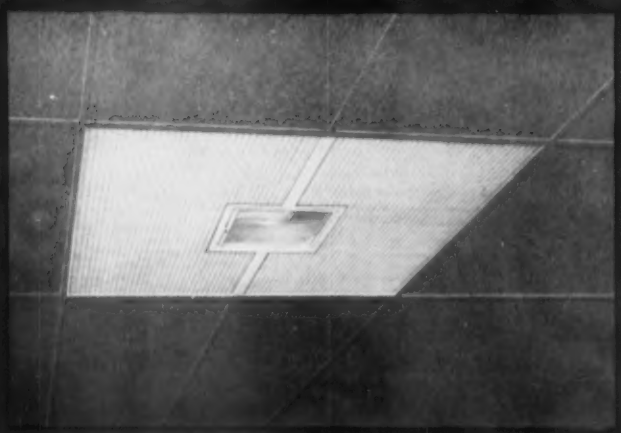




Kleinhans' Men's Store, Buffalo, New York
fixtures by R & W Wiley, Inc., Buffalo, New York

FOR THE LOUVER THAT ALLOWS YOU COMPLETE FREEDOM OF LIGHTING DESIGN.....

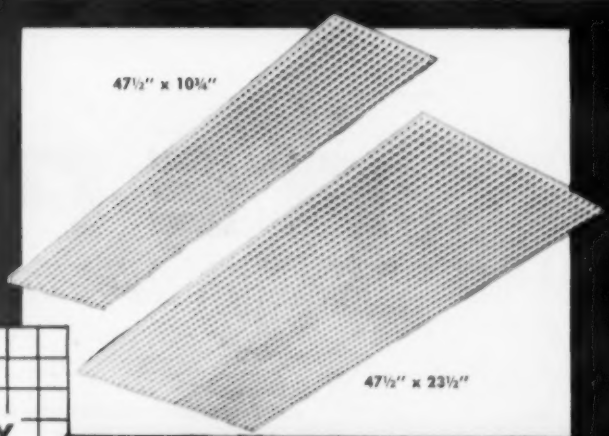
Specify... APL



It's a beautiful store—look at the lighting—notice the beautiful installation! For complete ceiling, individual fixtures, troffers, or modular designs, use American Plastic Louvers which combine the finest in lighting with modern beauty. *These interlocking, lightweight plastic louvers fit together without any visible interruption.* Just the right amount of traverse and longitudinal veins give maximum light at minimum brightness without trapping light.

UNEQUALED FEATURES OF AMERICAN LOUVERS...

- Color stable translucent white
- Lighter and easier to handle
- Easier to maintain, with ⅝" cells that permit fingertip grip
- Breaks up sound—reduces room noise
- Permits free air circulation
- Easily sawed, to fit anywhere
- Extreme heat resistance
- 45° x 45° light cutoff



Write for full specifications of American Plastic Louvers today.

AMERICAN LOUVER COMPANY
4240 NORTH SAYRE • CHICAGO 34, ILLINOIS

IN CONCRETE, TOO,

Western Electric Co., Cleveland Distribution Center, Salon, Ohio
General Contractor—Albert M. Higley Co., Cleveland, Ohio
Architect—Lockwood Greene Engineers, New York, N. Y.
Electrical Contractor—Hatfield Electric Co., Cleveland, Ohio

IN TO STAY... thousands of feet of Republic ELECTRUNITE E.M.T. are being covered by an 8-inch layer of concrete in Western Electric's new Salon, Ohio, distribution center. This quality raceway remains undamaged after pouring operations—assuring maximum dependability. Final plans for the project include construction of an office building in front of the distribution center. Approximately a quarter-million feet of Republic ELECTRUNITE E.M.T. will be used in the entire project.

REPUBLIC

REPUBLIC STEEL

World's Widest Range of Standard Steels

the best costs less installed

Smooth-Bending Republic Electrunite E.M.T.

Specifications for Western Electric's new distribution center in Solon, Ohio, called for thousands of feet of lightweight electrical raceways. Hatfield Electric Company, contractors on the job, chose Republic ELECTRUNITE E.M.T. because of the excellent results it had given them in the past. They knew they could expect easy, economical installation, as well as great dependability.

Rigid controls during manufacturing give ELECTRUNITE E.M.T. complete uniformity. The resulting high ductility leaves surfaces smooth and unwrinkled after bending. Compression-type couplings and connectors mean no threads to cut, no runs to turn. The light weight of ELECTRUNITE E.M.T. makes for ease of handling. Exclusive "Inch-Marks" and "Guide-Lines" make any installation easier. For all these reasons, costly delays are eliminated . . . work goes ahead on schedule.

ELECTRUNITE's tightly adhering galvanized coating protects against corrosion. It won't chip or flake off during bending. And because threading is not required, this coating remains unbroken. Uniform concentricity of ELECTRUNITE E.M.T. assures snug fit of couplings and connectors—thus shutting out moisture and concrete. Hundreds of millions of feet of this quality conduit have been installed in concrete. Installations made more than 25 years ago continue to report trouble-free service.

Ease of installation and proved dependability are BIG reasons for checking the many advantages of Republic ELECTRUNITE E.M.T. It's produced to ASA Specifications C-80.3, Federal Specifications WW-T-806, and carries the Underwriters' Seal of Inspection. Send coupon today for additional information.

REPUBLIC BENDER turns out precise bends. "Guide-Line" keeps bends in correct plane, eliminating costly "wows". "Inch-Marks" divide every length of ELECTRUNITE E.M.T. into feet and inches—make quick measurement a cinch. Both are exclusive features available in ½″, ¾″, 1″, and 1¼″ sizes.

COMPRESSION-TYPE COUPLINGS AND CONNECTORS mean no threads to cut, no runs to turn. This is a real advantage, particularly where space is limited. Exclusive "inside knurling" reduces friction—makes wire-pulling as much as 30% easier. ELECTRUNITE E.M.T. is lightweight, too. For instance, fifty-thousand feet (50,000′) of ¾″ Republic E.M.T. can save as much as 16 tons in dead weight.

STEEL

and Steel Products

REPUBLIC STEEL CORPORATION
STEEL AND TUBES DIVISION
DEPT. C-3840R
212 EAST 131st STREET, CLEVELAND 8, OHIO

Gentlemen:
Please send me additional information on Republic ELECTRUNITE® E.M.T.

Name_____ Title_____

Company_____

Address_____

City_____ Zone____ State_____

Pleasing Low Brightness Lighting for Bank Customers, Personnel and Management — by LITECONTROL

To give you an idea of the efficiency of this lighting installation, the photographer who took the picture found it unnecessary to use any auxiliary lighting. *Yet there's no glare!*

The brightness is very, very low, puts no strain on the eyes, eases paper work (and minimizes errors) by customers and the bank staff and provides a very comfortable interior. The high efficiency of the illumination is proved by the intensity levels reached with 3-lamp fixtures.

This is another example of good functional lighting supplied by *standard*, cost-saving LITECONTROL fixtures. It happens to be a bank installation but it could be a school, office, store or plant — all of which are currently benefiting by LITECONTROL equipment — everywhere.

INSTALLATION:
Winchester Trust Company, Winchester, Mass.
AREA SHOWN: General bank area.
ARCHITECT:
Hutchins & French, Boston, Mass.
ELECTRICAL ENGINEER:
Cleverdon Varney & Pike, Boston, Mass.
ELECTRICAL CONTRACTOR:
Barges Electric Co., Watertown, Mass.
FIXTURES:
Litecontrol No. 8334RS 3-lamp recessed fixtures, using Holophane No. 6024 acrylic lenses, and 3 special No. 8384RS 8-lamp recessed 4' x 4' fixtures with No. 6024 lenses.
CEILING HEIGHT: 10'-0".
FIXTURE SPACING: 8'-0".
INTENSITY:
95 foot-candles average on top of tellers' counters;
85 foot-candles average throughout room, at working level.

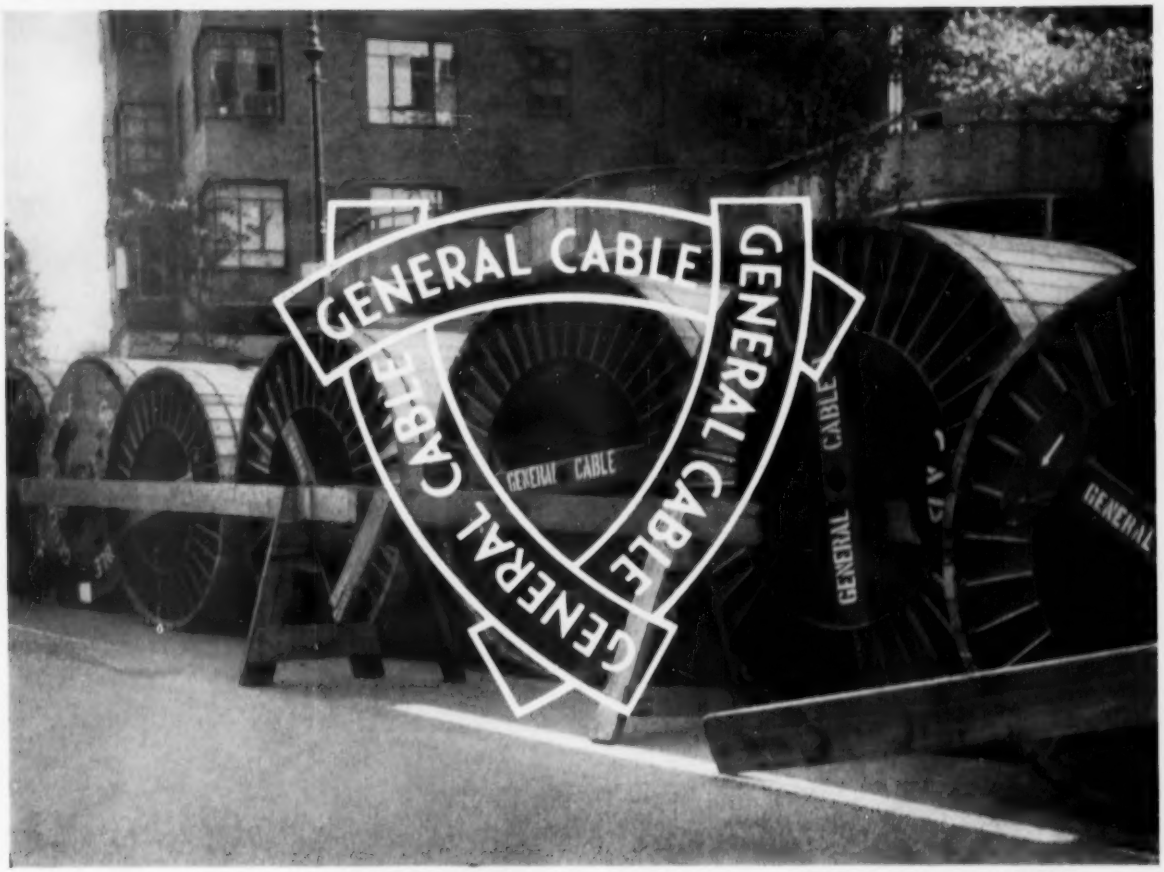
LITECONTROL *Fixtures*

KEEP UPKEEP DOWN

LITECONTROL CORPORATION, 36 Pleasant Street, Watertown 72, Massachusetts

DESIGNERS, ENGINEERS AND MANUFACTURERS OF FLUORESCENT LIGHTING EQUIPMENT DISTRIBUTED ONLY THROUGH ACCREDITED WHOLESALERS

GENERAL CABLE BACKS YOU UP



on the job

AVAILABILITY: Immediate delivery everywhere, through over 500 Authorized Distributors, backed up by complete inventories of wire and cable in all the General Cable Distributing Centers.

SERVICE: Experienced and trained representatives and engineers to help you on the job.

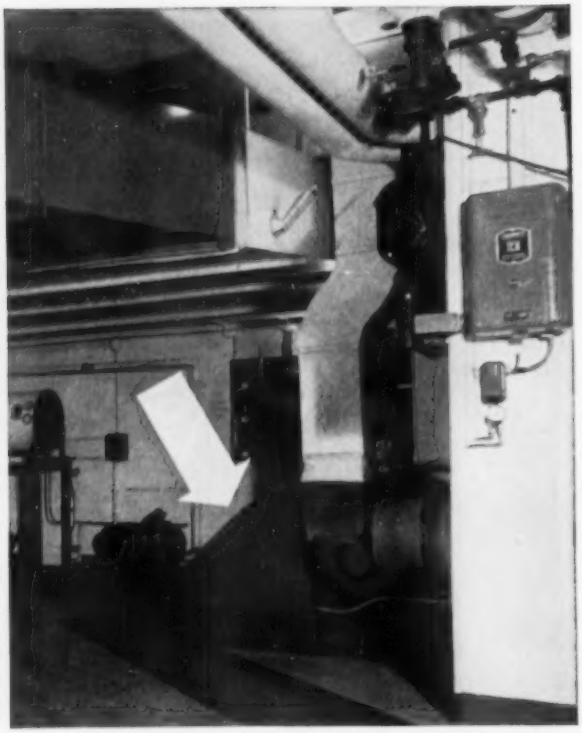
QUALITY: General Cable quality, made in 21 modern manufacturing units to rigid General Cable standards. Quality inspection from raw materials to final packaging.

General Cable backs you up on the job with the *three things you need* to make it easier for you and to keep your jobs on schedule . . . the finest service anywhere.

for quality and service... **specify GENERAL CABLE**

GENERAL CABLE CORPORATION • 420 Lexington Avenue, New York 17, N. Y. • Offices and Distributing Centers Coast-to-Coast

FROM TELEPHONE BOOTHS . . . TO INDUSTRIAL PLANTS



. . . here's the most versatile package unit that ever solved a ventilating problem!

American Blower Utility Set

We call them utility sets because they handle such a wide variety of ventilating problems.

Self-contained, American Blower Utility Sets, in a wide range of sizes and capacities, are used to supply or exhaust air in a wide variety of applications requiring a duct system. That means from small-capacity driers, laboratory exhaust systems, to the supply and exhaust requirements in hard-to-reach areas of public buildings, apartments, schools, hospitals, or industrial plants.

As individual package units, they are easy to install, economical to operate. And they're engineered by American Blower—specialists in the design and manufacture of air-handling and air-conditioning equipment for over 75 years. Call our nearest branch office today for full information; or write: American Blower Division of American-Standard, Detroit 32, Michigan. In Canada: Canadian Sirocco products, Windsor, Ontario.

AMERICAN BLOWER

Division of AMERICAN-Standard

VSC-L

BURNDY

57-20

NORWALK, CONNECT. • SCARBORO, CANADA

printed in U.S.A.

BURNDY

HYLUGS

now packed in faster, foolproof

FLIP-TOP BOX

Now — the best way to connect is also the handiest way — with Burndy Hylugs packed in the new foolproof, faster flip-top box! Hylug and wire sizes are clearly shown on every box, together with an actual "size-guide" Hylug drawing. No more fussing and fumbling for loose connectors. The flip-top box stays closed — fits snugly in your kit. On house wiring, motor repairs — for all of your small stranded wire connections . . . use Burndy Hylugs — indent on any side of barrel. Hylugs are one-piece in construction. Buy them today!

Y10M HYTOOL

You get lots to like—reliable, fast, low-cost electrical connection, with the famous Burndy Hytool: It provides handy wire cutter in nose and uniform controlled indent.

HYLUGS AND HYLINKS SHOWN ACTUAL SIZE

YAV18	YAV18-T5	YAV14-T5	YAV14	YAV14-T2
YAV18-T7	YAV10	YAV10-T3	YAV10-T2	YAV10-T4
YAV8C-L	YAV8C-L1	YAV8C-L2	YAV8C-L3	YAV14-T32F
YAV14-T34F	YAV10-T21F	YAV10-T23F	YAD14-H5	YAV14-H
YAV14-H2	YBV14-T1	YBV14-T3	YBV14	YBV10
BURNDY HYLUGS are available in the flip-top box thru No. 8. In sturdy corrugated boxes up to 2000 MCM.	YSV18	YSV14	YSV10	YSV8C-L

BURNDY

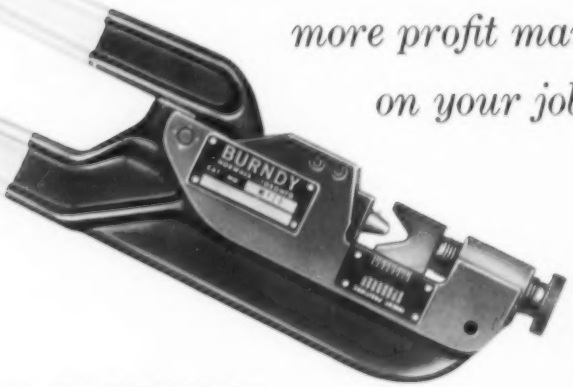
57-20

NORWALK, CONNECT. • SCARBORO, CANADA

printed in U.S.A.

HYTOOL MY29

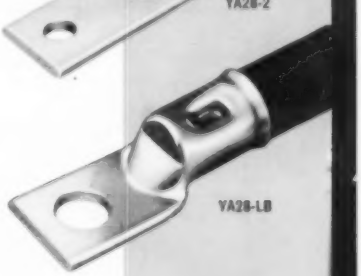
faster, better
connections mean
more profit margin
on your jobs!



COST SAVING COMPRESSION CONNECTIONS FOR LARGE WIRES...

The speed of a tool-installed compression connector means more connections per hour — more work finished faster. And since the tool controls the connection you know it's a good connection every time. The hand operated MY29 will handle all wires from No. 8 thru 250 MCM. A twist of the wrist sets the movable die for any size—no replacement of dies is necessary. For the larger cables up to 500 MCM the light nine pound Y34A provides 18,000 pounds of crimping force — a cut-off valve signals when the indent is complete. Between these tools you can handle most of the wiring jobs in your daily work. Your men will thank you too — it makes their jobs that much easier.

ASK YOUR BURNDY DISTRIBUTOR FOR A DEMONSTRATION



BURNDY

NORWALK, CONNECT. • SCARBORO, CANADA

Make Bull Dog your Pet Tape!

There's a
BULL DOG TAPE
for every purpose

- **FRICTION**
- **RUBBER**
- **PLASTIC**

BULL DOG TAPE is a man's best friend! Delivers thoroughbred performance every time. It goes on fast . . . sticks tight and stays tight. Splices neatly . . . extra strong and non-ravelling. High dielectric strength for complete all-around electrical protection. BULL DOG is *tough*, too . . . resists weather and moisture . . . stands up longer on the job!

Sold only through verified wholesalers

Another quality product of

BOSTON BOSTON WOVEN HOSE & RUBBER COMPANY
BOSTON 3, MASSACHUSETTS

Also manufacturers of Garden Hose · Nozzles · Matting · Stair Treads

Write for a better way to bag new business

If you're gunning for more business from new construction, Dodge Reports can help improve your aim. They point out your *live* prospects . . . put an end to the hit-or-miss method of finding business. If you would like to see how Dodge Reports can build your business . . . help your profits mount, just read this coupon, and mail it today!

TO: **DODGE REPORTS,** DEPT. 98, 119 WEST 40th STREET, NEW YORK 18, N. Y.

Yes! I'd like to see how to get more business by knowing in advance who's going to build, what, when, where.

I want to know whom to contact and when to submit bids.

I'd like to see some Dodge Reports, and I'd like a copy of your booklet that tells how to use this accurate, daily, up-to-the-minute construction news service.

I understand that I can pick just the area in the 37 Eastern States and the type of construction activity that interests me. Also, that I won't have to wade through mounds of data to find the information I need.

I'm interested in General Building ☐ **House Construction** ☐ **Engineering (Heavy Construction)** ☐

In the Following Area: _____

NAME _____

ADDRESS _____

CITY _____ ZONE _____ STATE _____

Dodge Reports
For Timed Selling to the Construction Industry

BALLAST BONUSES

Here's how you can

GET THE MOST FROM EVERY LIGHTING DOLLAR!

The greatest dollar value in fluorescent lighting is a combination of good fixture design and quality components that will provide the user with the finest lighting possible.

WHY A QUALITY BALLAST?

Fluorescent lamps are only as good as the ballasts. General Electric's Lamp Division reports that:

"Life, light output, and wattage savings of all fluorescent lamps are based on the delivery of specified electrical values to the lamp. The ballast controls these electrical values. Tests indicate that ballasts which deliver improper values reduce lamp life as much as 50% and light output as much as 30% below ratings. This means the user may need to install up to ⅓ more fixtures to obtain the same lighting level . . . and maintenance costs may be twice as high as they should be.

"To protect against exorbitant lighting costs the customer should ascertain that his fixtures are equipped with properly designed ballasts."

WHY G-E BALLASTS?

General Electric ballasts are designed to meet these requirements and provide you with the performance you need. Here's some big reasons why:

- **LAMP-MATCHED DESIGN.** G-E ballasts meet specific lamp requirements. You save two ways . . . fewer lamp replacements and more light from your installation.
- **LONGER BALLAST LIFE.** G-E ballasts are designed to operate cooler than CBM standards. This reduction in temperature rise can give you half again as much ballast life.
- **FULL LINE.** You can get all of your ballasts from one dependable source. And, if you need ballasts for special applications, G-E engineers can design them.
- **SUPERIOR QUALITY CONTROL.** Uniformly good ballasts help save lighting dollars on early replacement and maintenance costs.
- **PROVED PRODUCT LEADERSHIP.** Experienced ballast engineers are constantly improving ballasting methods, assuring you of the quality you expect when you specify G-E ballasts for the lighting fixtures you install.

Everyone benefits from G-E ballasts: Users get more efficient lighting; fixture manufacturers are assured of quality components and low complaint expense; specifiers are certain that their recommendation will satisfy their client with lower lighting costs; and, contractors save on costly callbacks.

Whether you consider initial or operating costs, you will save by specifying General Electric quality ballasts. Quality does cost less.

Inside you'll find the complete story of some big "extra" reasons why General Electric fluorescent ballasts are your best buy!

Progress Is Our Most Important Product

GENERAL ELECTRIC

BALLAST BONUS NO. 1

SOUND RATING to help you eliminate ballast noise complaints

Every G-E ballast design is tested to give you quieter ballasts.

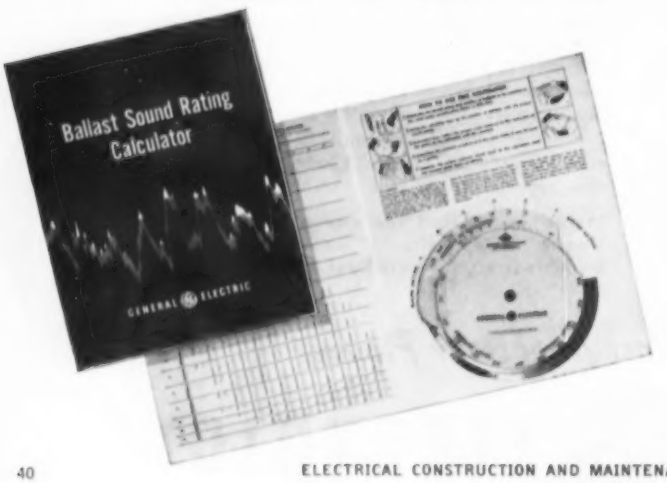
When you specify G-E ballasts you will give your customers a more efficient fluorescent lighting installation and reduce noise complaints to a minimum because General Electric has reduced ballast noise level to the lowest practical level in each of its many ballast models. Here's how General Electric's exclusive sound-rating system works for you!

ALL GENERAL ELECTRIC BALLASTS ARE SOUND RATED under this system. This feature classifies ballasts by noise level, making it easy for you to select a ballast designed to meet your individual lighting installation requirements.

To choose the quietest ballast possible for your specific application, you should take into account the acoustical characteristics of the rooms involved, the number of fixtures to be installed, and the average ambient noise level of the room. The next step is to make sure the fixtures you choose are well constructed and properly installed.

BALLAST SOUND RATING CALCULATOR. This newest contribution to the system helps you to determine beforehand whether or not you will encounter a ballast noise problem . . . and help you eliminate costly complaints after installation.

Next time you specify a fluorescent lighting installation, take advantage of this big extra and take the guesswork out of choosing the right ballast-fixture combination to meet your specific sound level requirements. Always specify General Electric *sound-rated* ballasts.



If you desire a copy of this new copyrighted General Electric Sound Rating Calculator, fill out the coupon at the end of this advertisement and send it in.

BALLAST BONUS NO. 2

ENGINEERING SERVICES to help you with your tough application or service problems

General Electric's extensive application and service engineering can perform services for you which no other ballast manufacturer provides

APPLICATION ENGINEERING. More than 50 specially trained General Electric ballast sales engineers are located throughout the U.S. to help you with on-the-spot application problems. Their knowledge of fluorescent lighting, and especially ballasts, can be of great help to you in determining the best way to design your installations to provide the most efficient and dependable operation.

Design engineers from the General Electric Ballast Department can be of great assistance to you on especially involved application problems.

EXTENSIVE SERVICE ENGINEERING. This engineering help offered by General Electric to its ballast purchasers is unmatched by any other fluorescent ballast manufacturer. Trained General Electric service engineers are available on call to help you and your customers immediately whenever or wherever a ballast problem arises.

If you haven't called on these services yet, do so the next time you have a difficult application or service problem concerning ballasts. Your nearest General Electric ballast sales engineer will give your problem his prompt attention.

BALLAST BONUS NO. 3

G-E Ballast service centers help you save time and money

More than 1200 General Electric Ballast Service Centers in convenient locations stock General Electric ballasts to help your customers get ***immediate*** ballast replacements.

YOU SAVE TIME AND MONEY because there's no red tape involved when you need replacements on ballasts which fail within warranty. These service centers are authorized to make ***free*** replacements of General Electric ballasts which fail within warranty . . . right off the shelf!

SERVICE CENTER DISTRIBUTORS can also replace ***any*** make ballast with a high quality General Electric unit. They can supply you with emergency needs directly from stock.

G.E.'s EXTENSIVE BALLAST WAREHOUSE network is available to help you meet your ballast requirements, too. You can count on G.E.'s extensive warehouse network for immediate delivery on most popular models from local stock.

You can take advantage of ***all*** of these time and money saving ballast bonuses by specifying General Electric "sound-rated" ballasts for every fluorescent lighting installation you design or install. You can learn more about these "extra" features by calling your nearby General Electric Apparatus Sales Office.

GENERAL ELECTRIC

General Electric Company
Section A401-55
Schenectady 5, N. Y.

Gentlemen:

Please send me copies of the following important General Electric ballast publications:

..... Flora Ballast Tells Her Story, GEA-5731
..... General Electric Report on Ballast Sound, GED-3164
..... Ballast Sound Rating Calculator, GEN-147 ($1.00 per copy)
..... Let's Talk About Ballast Heating, GED-3328
..... Why G-E Fluorescent Ballasts Are Your Best Ballast Buy, GEA-6249

Name .....
Company .....
Address .....
City ..... **State** .....

FOR ADDITIONAL BALLAST INFORMATION WRITE FOR THESE IMPORTANT BALLAST PUBLICATIONS

Look for this "sign of quality" on every fixture you specify!

General Electric's New Fluoroflood Fixture masters all these lighting jobs . . . and more!

Here's the fluorescent floodlight you've been looking for. Consider these features:

IT'S VERSATILE—Look at all the applications pictured! And there are many other areas all around you where this General Electric Fluoroflood Fixture will do the job best . . . in fact, anywhere you need "light by the foot or yard."

IT'S ECONOMICAL—You'll be pleased with the low price your General Electric floodlight distributor will quote. The Fluoroflood is quick and easy to install . . . the eight-foot unit weighs only nine pounds . . . it's less expensive to operate and maintain . . . lamp life is six times longer and power costs are only one-fifth those of an equivalent filament installation.

IT'S FLEXIBLE—Mount it overhead . . . mount it below . . . aim it at any angle (built-in aiming) . . . mount it directly or on brackets . . . use it open or with clear plastic cover . . . almost any combination of lengths (standard four-, six-, eight-, and nine-foot models, and others on special order) to do your job.

IT REALLY PERFORMS—Gives improved visibility . . . five times more light per watt with Power Groove lamps than from filament . . . even, uniform light distribution . . . no "hot spots" . . . cool, crisp, white fluorescent light reduces glare, gives comfortable, attractive seeing.

Get the full story of this new development in general-purpose fluorescent floodlighting! Contact your General Electric floodlight distributor or write Section 451-197, General Electric Company, Schenectady, New York.

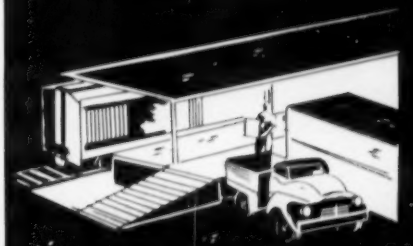
Progress Is Our Most Important Product

GENERAL ELECTRIC

Building fronts

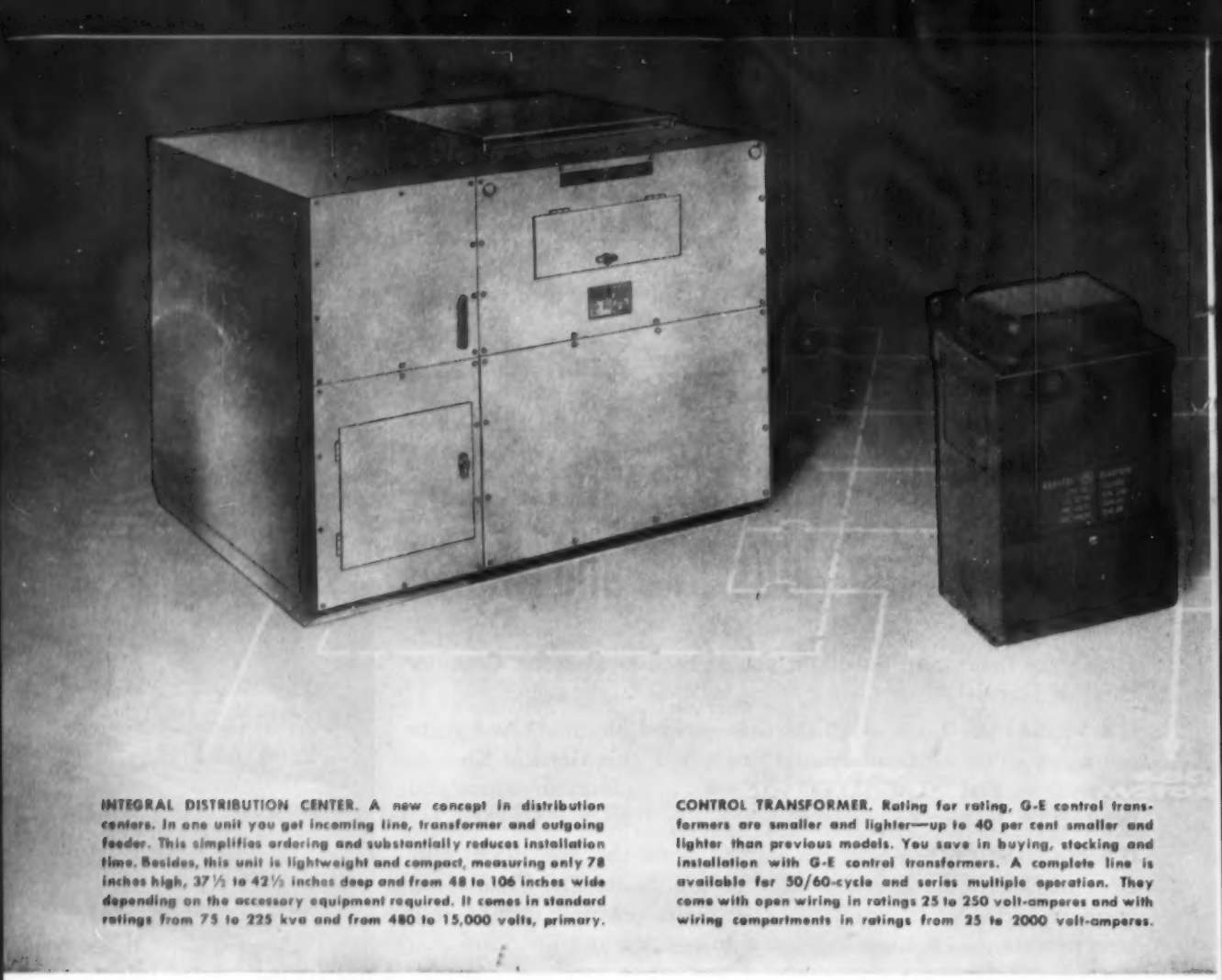
Outdoor businesses

Plant entrances


Loading docks

Service stations

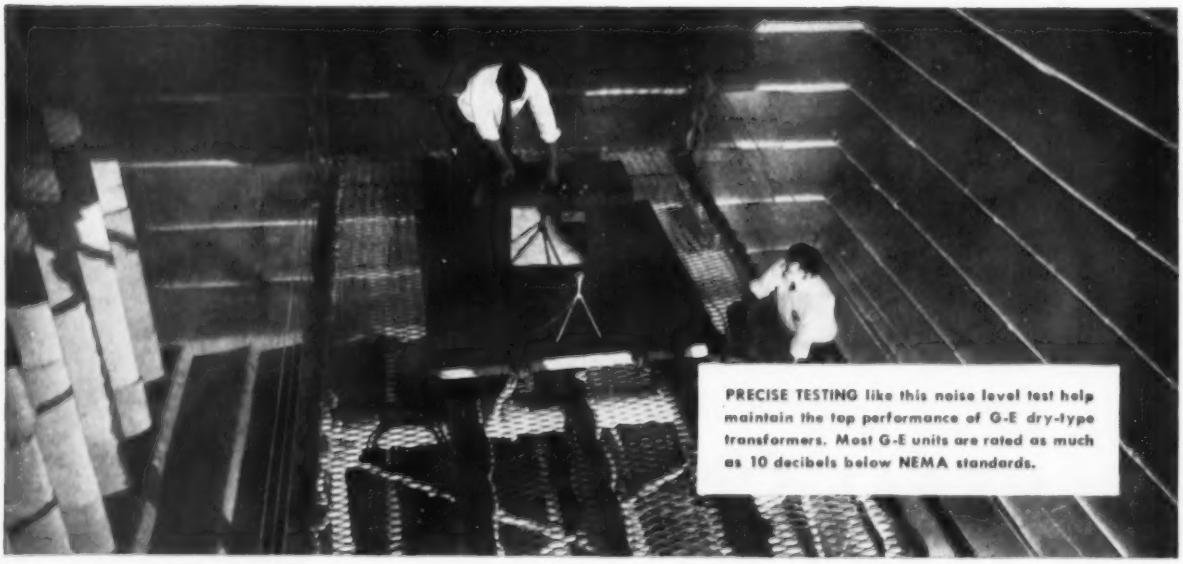
Signs



INTEGRAL DISTRIBUTION CENTER. A new concept in distribution centers. In one unit you get incoming line, transformer and outgoing feeder. This simplifies ordering and substantially reduces installation time. Besides, this unit is lightweight and compact, measuring only 78 inches high, 37½ to 42½ inches deep and from 48 to 106 inches wide depending on the accessory equipment required. It comes in standard ratings from 75 to 225 kva and from 480 to 15,000 volts, primary.

CONTROL TRANSFORMER. Rating for rating, G-E control transformers are smaller and lighter—up to 40 per cent smaller and lighter than previous models. You save in buying, stocking and installation with G-E control transformers. A complete line is available for 50/60-cycle and series multiple operation. They come with open wiring in ratings 25 to 250 volt-amperes and with wiring compartments in ratings from 25 to 2000 volt-amperes.

From substation to load—cut costs, increase



PRECISE TESTING like this noise level test help maintain the top performance of G-E dry-type transformers. Most G-E units are rated as much as 10 decibels below NEMA standards.

TYPE M TRANSFORMERS. Compact, quiet and easy to install. You can mount this unit on its side . . . on the wall or floor . . . upright . . . on its back . . . on the ceiling. General Electric Type M transformers come in 3-phase ratings up to 150 kva and are designed specifically for applications requiring low noise level—45 decibels or below. Single-phase Type M transformers are now available in ratings up to 50 kva. And you get quick delivery, too.

MERCURY LAMP TRANSFORMERS. For your mercury lamp installation you want a dependable transformer with high power factor and low starting current. You get both plus low initial cost with General Electric mercury lamp transformers. Speedy installation is another big advantage. Just slip the nameplate aside and you have access to a spacious wiring compartment. Installation and maintenance are fast and simple because complete easy-to-read wiring instructions and diagrams are right where they are needed.

efficiency with G-E dry-type transformers

Only General Electric offers a complete line of dry-type transformers for distribution, stabilization, control, and utilization of power as you need it and *where* you need it!

Here is the way to simplify your transformer specifying, ordering and installation problems. Because you can get *the* dry-type transformer you *need* for most applications from your General Electric distributor, you save time and money, and get prompt delivery of popular models.

FIVE BASIC TYPES of quieter, smaller, lighter-than-ever dry-type transformers are available from General Electric: integral distribution centers, and Type M, control, mercury lamp, and voltage stabilizing transformers. And . . .

GENERAL ELECTRIC ENGINEERS will be happy to give you help on your system needs—just call your nearby G-E Apparatus Sales Office. For more detailed product information, write Section 410-48 and ask for Bulletins GEA-6619, GED-2767, and GEC-1440. G.E. Co., Schenectady 5, N.Y.

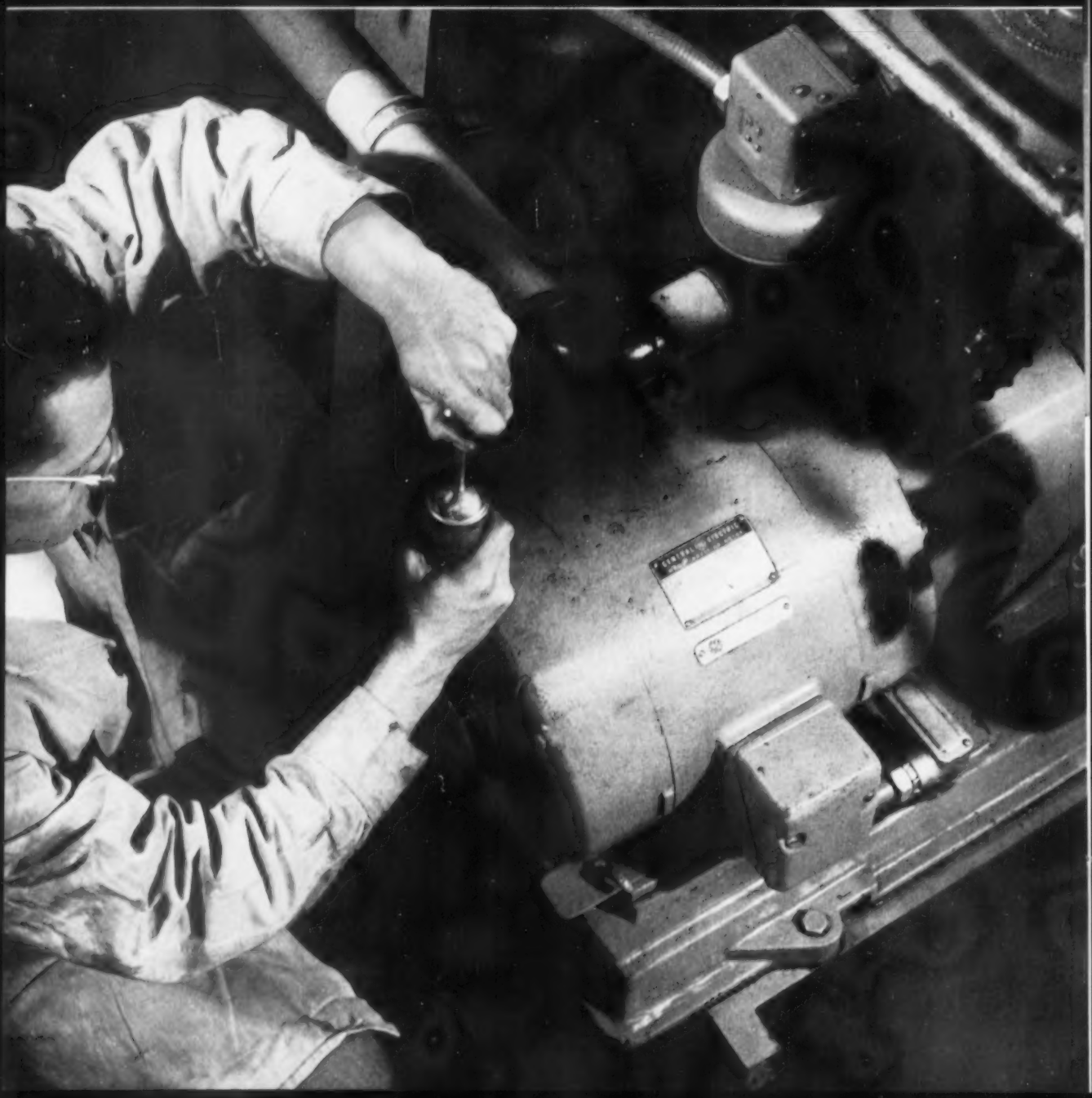
GENERAL ELECTRIC

compact . . . power-packed

New General Electric

NOW EASIER

COMPLETE LINE AVAILABLE

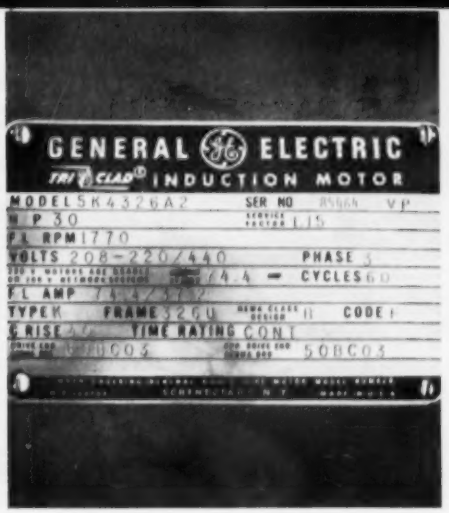


TRI 55 CLAD Motors are . . .

TO MAINTAIN

THROUGH 125-HORSEPOWER

FAST END-SHIELD REMOVAL is possible because of Tri-Clad '55' motor's rugged knock-off lugs. Remove four bolts, tap on knock-off lugs and end-shield is off to permit easy repositioning or quick motor inspection.



EASIER TO MAINTAIN, Tri-Clad '55' motors utilize a stainless-steel, non-corrosive nameplate to give complete rating information including AFMBA bearing numbers. Separate steel plate gives connection diagrams.

EASIER TO INSTALL, Tri-Clad '55' motors use Perma-numbered leads to simplify wiring, speed motor hook-up. Numbers are stamped on terminals and printed on every half-inch of Geoprene® leads.

immediate shipment . . . all ratings

The need for faster production schedules and reduced production costs has made motor maintenance of prime concern to motor users. Modern motors must be easy to inspect and maintain without loss of production time due to routine maintenance.

TO MEET THIS NEED, G-E Tri-Clad '55' motors feature an oversize grease reservoir which contains enough grease for normal 5-year operation. Yet, new grease can be added while the motor is running. Other easy maintenance features are described above.

EASE OF MAINTENANCE, however, is not the whole Tri-Clad '55' motor story. Experienced G-E motor engineers have used revolutionary materials and the most modern production and testing facilities to provide a motor that is not only easier to maintain, but also more reliable and easier to install.

Formerly available only to 30-hp, these proven Tri-Clad '55' motors are now available for immediate shipment—usually from nearby warehouse stocks—up through 125-hp.

FOR FULL INFORMATION on the complete Tri-Clad '55' motor line contact your nearest G-E Apparatus Sales Office or Distributor.

Section E891-7
GENERAL ELECTRIC COMPANY
Schenectady 5, New York

Please send me the following publications:

☐ **FREE BULLETIN (GEA-6602)** describes advanced features of new Tri-Clad '55' motors through 125-hp.

☐ **FREE SLIDE RULE (GEN-148)** to determine weight and space-saving benefits of new Tri-Clad '55' motors.

NAME _____

TITLE _____

COMPANY _____

ADDRESS _____

CITY & STATE _____

Progress Is Our Most Important Product

GENERAL ELECTRIC

COMMERCIAL POWER DISTRIBUTION

SAVINGS OF $90,000 were obtained using G-E 480Y/277-volt systems in Exchange Bank, Braniff Building in background.

General Electric system-engineered equipment

PLANNING: W. Marshall, J. Glendinning, G-E; consultants J. M. Guerrero, E. B. Gamble; G. M. Bostock, Park V. P.

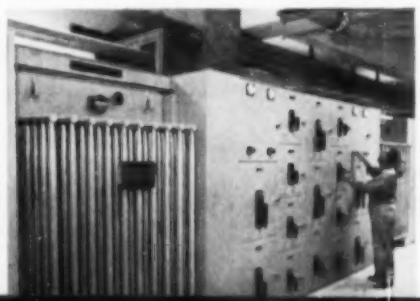
HIGH VOLTAGE LIGHTING at 277 volts creates savings by combining light, power source. Modular design permits flexibility.

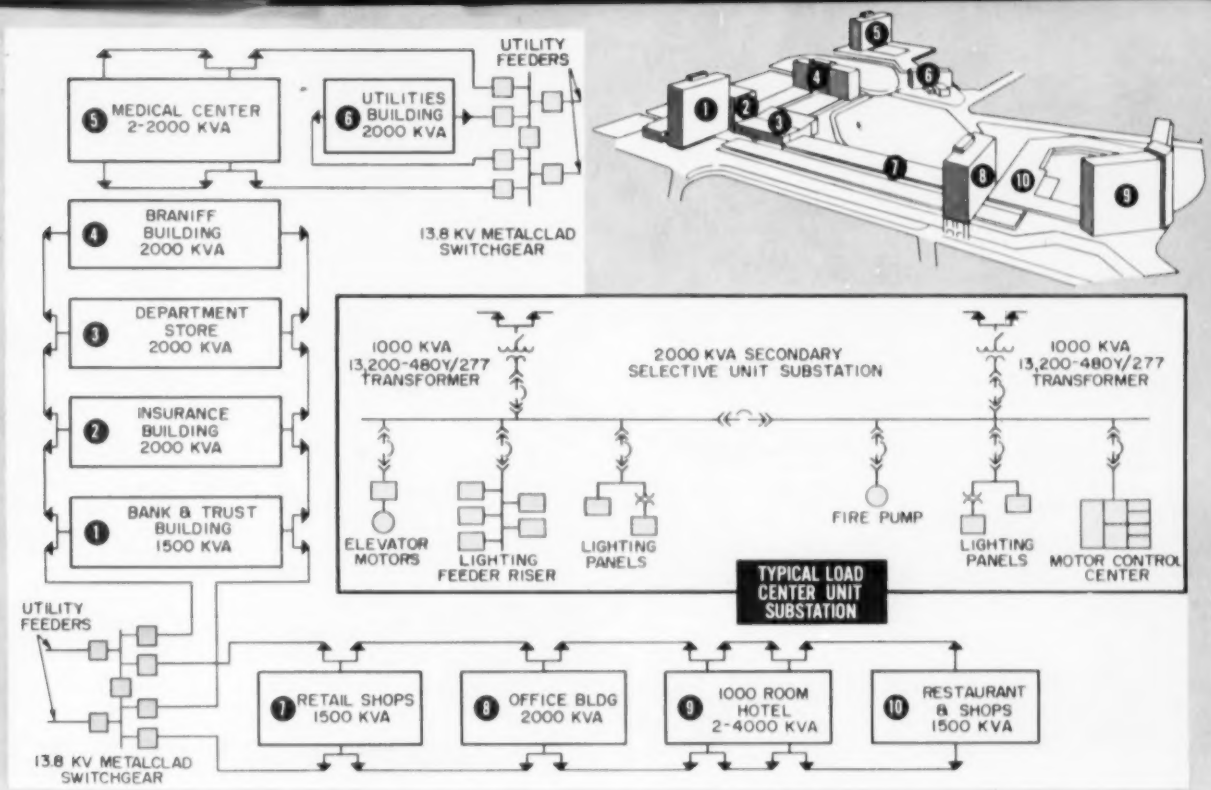
ECONOMICAL power distribution is provided by feeder busway. 30 kva, 110-V transformer serves office equipment.

COMPACT G-E Type DA7093 motor control center takes power from feeders to control all motors safely.

1500 KVA double-ended load center unit substation is typical of the units that will supply power in Exchange Park buildings.

PROJECT POWER is from two line-ups of G-E 13.8 kv metalclad switchgear. Unit shown is located in Bank basement.




UTILITY FEEDERS
5 MEDICAL CENTER 2-2000 KVA
6 UTILITIES BUILDING 2000 KVA
4 BRANIFF BUILDING 2000 KVA
3 DEPARTMENT STORE 2000 KVA
2 INSURANCE BUILDING 2000 KVA
1 BANK & TRUST BUILDING 1500 KVA
13.8 KV METALCLAD SWITCHGEAR
1000 KVA 13,200-480Y/277 TRANSFORMER
2000 KVA SECONDARY SELECTIVE UNIT SUBSTATION
1000 KVA 13,200-480Y/277 TRANSFORMER
ELEVATOR MOTORS
LIGHTING FEEDER RISER
LIGHTING PANELS
FIRE PUMP
LIGHTING PANELS
MOTOR CONTROL CENTER
TYPICAL LOAD CENTER UNIT SUBSTATION
UTILITY FEEDERS
7 RETAIL SHOPS 1500 KVA
8 OFFICE BLDG 2000 KVA
9 1000 ROOM HOTEL 2-4000 KVA
10 RESTAURANT & SHOPS 1500 KVA
13.8 KV METALCLAD SWITCHGEAR

FLEXIBLE, ECONOMICAL POWER distribution system for entire Park Project is contained in one-line diagram. Numbers key equipment to Project buildings. Completed Utility Building also uses General Electric 480Y/277-volt equipment.

serves power needs of "city within a city"

$125 million Exchange Park Project in Dallas shows how General Electric's "system approach" is key to flexible, economical commercial power distribution.

To keep pace with the Southwest's vigorous economic growth, a $125 million commercial center is rising on 120 acres four miles from downtown Dallas. Known as Exchange Park, this community represents one of the most advanced city-within-a-city developments yet attempted in the United States. It is scheduled for 1960 completion. Nine major buildings, parking for 15,000 cars, 40-foot-wide air conditioned malls, 150 retail shops, and other facilities will enable shoppers to take care of every personal and business need in scientific comfort. Already completed: Exchange Bank and Utility Building.

SELECTING THE BEST POWER DISTRIBUTION SYSTEM, to satisfy Exchange Park's heavy load concentration efficiently and economically, required thorough system analysis early in project planning. G-E engineers, working closely with Mr. George M. Bostock, Vice-president and Engineering Manager of Exchange Park and his consultants*, recommended a 480Y/277-volt secondary selective system as optimum. General Electric also provided basic system layout, service engineering and installation assistance at the site.

ADDED VALUES stem from adoption of G-E system recommendations. Exchange Park's 13.2 kv distribution system has capacity for load growth. Secondary selective system features permit reliable operation. Utilization of 480Y/277-volt system means fewer, less-metal circuits and substantial dollar savings. Using 480Y/277-volt equipment in only two of nine buildings, for example, saved $90,000.

GENERAL ELECTRIC SYSTEM ENGINEERING CAN HELP YOU on your construction project. Call on G-E engineers early in your planning when they can be of greatest value. Contact your nearest G-E Apparatus Sales Office or write General Electric Co., Section 680-12, Schenectady 5, N. Y.

*Architect: Lane, Gamble and Associates Consultants: Blum and Guerrero Electrical Contractors: Fischbach and Moore; Superior Electric Co.

Engineered Electrical Systems for Commercial Buildings

GENERAL ELECTRIC

Sylva-Lume. Sylvania modular area-illumination system, *new this year!* Using a few standardized components . . . track grid system . . . form and color . . . you can custom-create over 100,000 different wall-to-wall lighting designs.

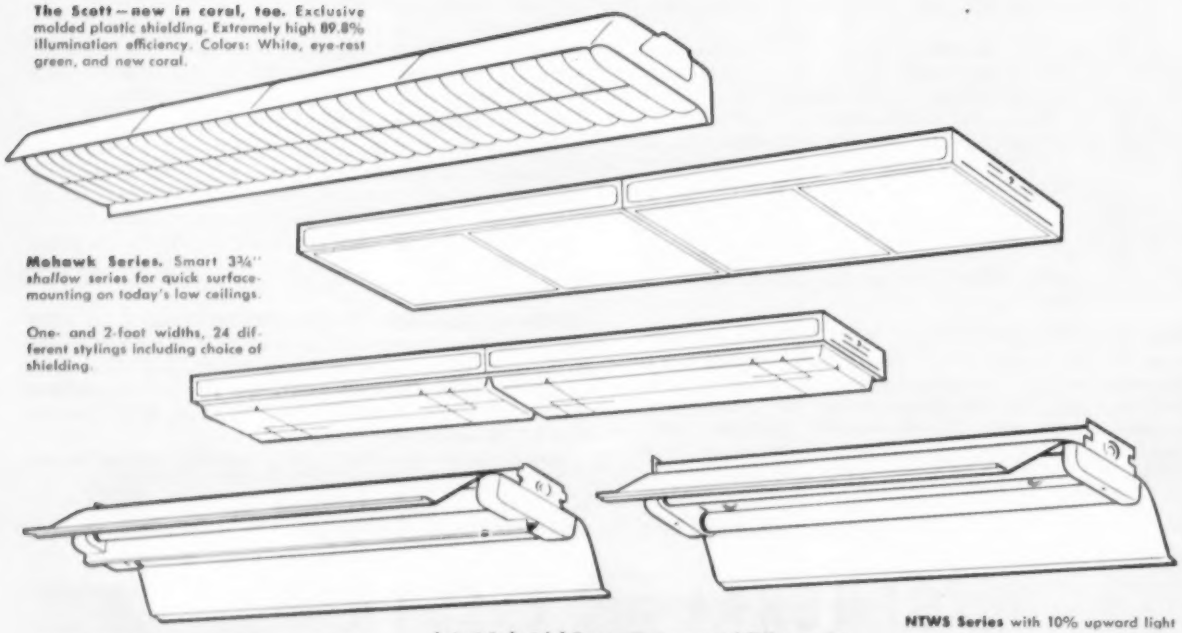
Sylvan-Aire. Sylvania linear system for area illumination. Rows of white corrugated plastic provide soft, *diffused* light . . . high foot-candle levels with minimum of shadow and glare. Plastic rolls out easily for maintenance.

Your FULL line of featured

The Scott—new in coral, too. Exclusive molded plastic shielding. Extremely high 89.8% illumination efficiency. Colors: White, eye-rest green, and new coral.

Mohawk Series. Smart 3¾" *shallow* series for quick surface-mounting on today's low ceilings.

One- and 2-foot widths, 24 different stylings including choice of shielding.

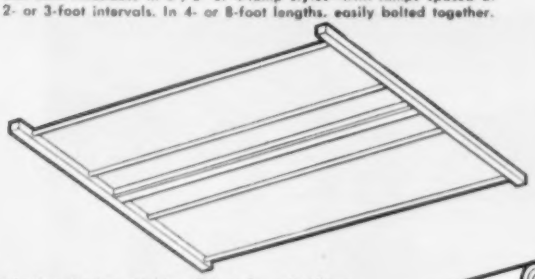


Diamond-"I" Series with 25% upward light

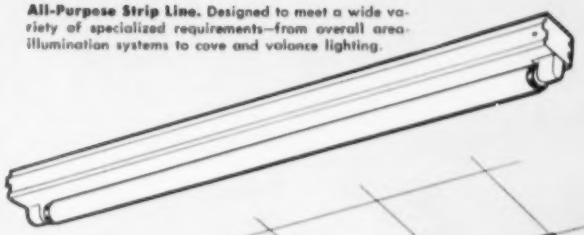
Latest Industrial Types. Meet or exceed RLM specs for plant lighting with increased upward light components.

NTWS Series with 10% upward light

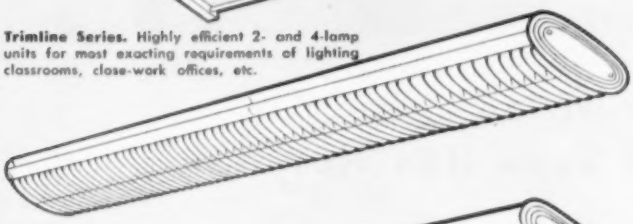
New "Outrigger" Fixture. Great timesaver and economical short cut for wall-to-wall lighting. Combines several lamps, spaced, on one unit. Available in 2-, 3- or 4-lamp styles—with lamps spaced at 2- or 3-foot intervals. In 4- or 8-foot lengths, easily bolted together.



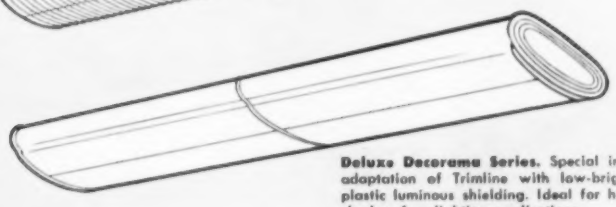
All-Purpose Strip Line. Designed to meet a wide variety of specialized requirements—from overall area-illumination systems to cove and valance lighting.



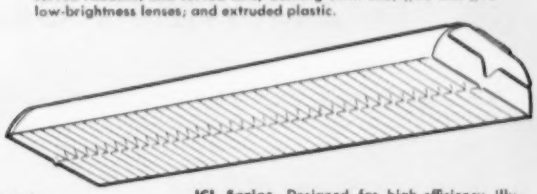
Trimline Series. Highly efficient 2- and 4-lamp units for most exacting requirements of lighting classrooms, close-work offices, etc.



Sylvania Troffers. Classic recessed lighting. Wide selection of shielding: 45° x 45° louvers, Corning flat-ribbed Albalite glass, curved Albalite, and curved lens; Corning Twin-Lite, #70 and #72 low-brightness lenses; and extruded plastic.



Deluxe Decorama Series. Special indirect-light adaptation of Trimline with low-brightness all-plastic luminous shielding. Ideal for high-quality, shadow-free lighting applications.



ICL Series. Designed for high-efficiency illumination with a strong downward component. Distribution is 40% upward light, 60% downward light.

SYLVANIA

Lighting Systems and Fixtures

blazing a long, long trail of product advantages

. . . to spur your sales

Every time you install a Sylvania Lighting System or Fixture, it speaks well for you . . . *sells* for you. You can depend on it to look and perform the way discriminating customers expect it to. It will label your work as true craftsmanship.

Shown on these pages are several modern lighting systems and fixtures—the *featured* Sylvania line. Here are lighting ideas, new thinking, modern aesthetic designs. And here is the finest lighting performance that money can buy, both in quantity and quality of light delivered.

Sell Sylvania—and link your name to the finest brand in lighting.

. . . to chop your costs

Sylvania's real payoff for you: precious man-hour savings on the job with fewer call-backs after the installation is completed.

Safe labor-saving devices are traditionally Sylvania's star attraction. Some are built in, some come as optional or low-cost accessories. The many man-hours saved are your assurance of substantial profits and greater leeway for job-winning bids.

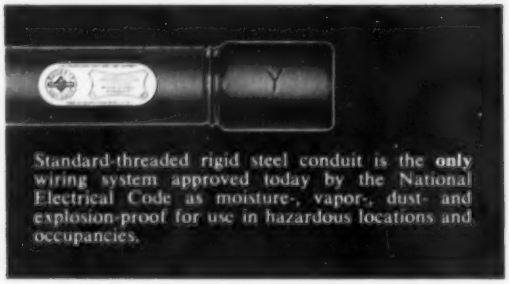
We suggest you look over the few Sylvania Fixtures and Systems shown here. Then ask your **Sylvania Fixture Specialist** or Select Distributor for full details. Write direct for complete catalog and the name of your nearest distributor.

SYLVANIA

SYLVANIA ELECTRIC PRODUCTS INC.
Dept. K40, Lighting Division—Fixtures
One 48th Street, Wheeling, W. Va.

. . . fastest growing name in sight

LIGHTING · RADIO · ELECTRONICS · TELEVISION · ATOMIC ENERGY



Standard-threaded rigid steel conduit is the **only** wiring system approved today by the National Electrical Code as moisture-, vapor-, dust- and explosion-proof for use in hazardous locations and occupancies.

YOUNGSTOWN "BUCKEYE" CONDUIT

. . . gives life-time wiring protection to Zanesville's Good Samaritan Hospital

Good Samaritan Hospital
Zanesville, Ohio

Architect: Dan A. Carmichael,
Columbus, Ohio
General Contractor:
Knowlton Construction Company
Bellefontaine, Ohio
Electrical Contractor:
Electrical Contractors, Inc.
Columbus, Ohio

Failure of its all-important electrical system will never interrupt the smooth operation of the Good Samaritan Hospital in Zanesville, Ohio. That's because the builder of this well known institution wisely specified Youngstown's Full Weight Rigid Steel "Buckeye" Conduit for protection of the wiring system from damaging elements such as water, moisture, vapor, dust and dirt.

If the proper functioning of **your** electrical wiring systems—in any location, under any condition—presents a problem, then Youngstown "Buckeye" Conduit should be your specification. Reports from across-the-nation tell us, "It's easier to bend and thread, wire fishing is faster and easier—and its superior corrosion-resistance gives a much longer service life after installation"

Remember, Youngstown is the only producer of rigid steel conduit that controls all its integrated operations from ore mine to finish threading. Thus, you can be sure each length is of the same high quality that has made "Buckeye" Conduit the accepted standard of leading owners, architects and contractors everywhere.

Delivery is no problem—because all leading industrial and electrical distributors carry complete and ample stocks. Why not call today for quick and efficient handling of your current requirements.

QUALITY YOUNGSTOWN SERVICE

THE YOUNGSTOWN SHEET AND TUBE COMPANY
Manufacturers of Carbon, Alloy and Yoloy Steel
General Offices - Youngstown 1, Ohio
District Sales Offices in Principal Cities

New! Both Light and Air through Glass Enclosed Troffers!

Multi-Vent Trofferlites in a typical interior also deliver draft-free, conditioned air.

Now! from one double-duty troffer the ULTIMATE in BOTH enclosed-troffer lighting and draft-free air conditioning!

multi-vent trofferlites by BENJAMIN

breathing conditioned air right through the lighting system

improve all 3

- lighting
- air conditioning
- ceiling beauty

Again from Benjamin . . . another First!

Now, all the beauty and illumination advantages of enclosed troffer lighting with a unit that also does double-duty as a superior air diffuser! Never before an opportunity like this *for architects* to enhance ceiling beauty and lighting effectiveness; *for engineers* to simplify mechanical and electrical plans; *for contractors* to save time, labor and effort with faster, more simplified installations.

Enclosed Multi-Vent Trofferlites are another joint engineering achievement of Pyle-National and Benjamin Electric creating another unprecedented opportunity for you to provide . . .

FINEST BENJAMIN TROFFER LIGHTING
PLUS THE LAST WORD IN AIR CONDITIONING

VERSATILITY IN LIGHT CONTROL. Choose from a wide range of Multi-Vent Trofferlites to meet the requirements of any environment or seeing task. Glass or plastic covers, steel or plastic louvers, baffled or open types are available.

NEW SAVINGS IN COST. Besides economies resulting from use of double-duty fixtures, savings are now even greater due to new installation short cuts and new, cost-cutting, time-saving maintenance features.

BENJAMIN
. . . always the source of good lighting

Now Setting the Pace in COMMERCIAL LIGHTING

BENJAMIN ELECTRIC MFG. CO., DES PLAINES, ILLINOIS
Send me without obligation, Multi-Vent Trofferlite bulletin No. Ad 6765
(attach to your letterhead please)

Multi-Vent® Air Diffuser by Pyle-National Co.
Trofferlite by Benjamin Electric Mfg. Co.

AD4C-201 Prd. in U. S. A.

Now!
ADVANCE FLUORESCENT LAMP BALLAST
CAT. NO. SEQM-240-S
CBM CERTIFIED
FOR TWO 48" T-12, 38W SLIMLINE LAMPS OR
FOR TWO 48" T-12, 40W INSTANT START LAMPS OR
FOR TWO 96" T-17, 40W INSTANT START LAMPS
118 VOLTS • 60 CYCLE • 430 M.A.
ADVANCE TRANSFORMER CO.

ADVANCE FLUORESCENT LAMP BALLASTS INDIVIDUALLY PACKAGED

Yes, now ADVANCE Quality Fluorescent Lamp Ballasts packaged in modern individual cartons are available from your authorized ADVANCE Distributor. These individually packaged ADVANCE Fluorescent Lamp Ballasts put an end to loose dangling lead wires, prevent damage to lead wire and assure you of factory fresh ballast stock always. End labels on the new individual cartons permit instant identification of ballast type, catalog number and pertinent electrical characteristics.

Your authorized distributor carries a complete stock of all popular ADVANCE ballasts to give immediate replacement service for any make fluorescent lamp ballast whenever replacement is necessary. Simply bring the inoperative ballast to any ADVANCE Service-Stocking Distributor. The ADVANCE cross-reference guide shows at a glance the replacement needed, and in a few moments, you can be back on the job with the correct ballast.

To give better customer service, save time and effort . . . insist on quality ADVANCE Fluorescent Lamp Ballasts in the new modern individual cartons.

For further details on how you can increase your ballast sales with ADVANCE Fluorescent Lamp Ballasts in modern individual cartons, contact your ADVANCE salesman, or write, phone or wire today.

ALL HPF BALLASTS CARRYING THE ADVANCE LABEL ARE DESIGNED TO CONFORM TO CBM SPECIFICATIONS

The Heart of the Lighting Industry

ADVANCE

CBM CERTIFIED

World's Largest Exclusive Manufacturer of Fluorescent Lamp Ballasts

TRANSFORMER CO.

2950 NO. WESTERN AVE. CHICAGO 18, ILL. U.S.A.

HOW Westinghouse

JOB-TAILORED FLUORESCENT LAMPS MEET YOUR LIGHTING NEEDS

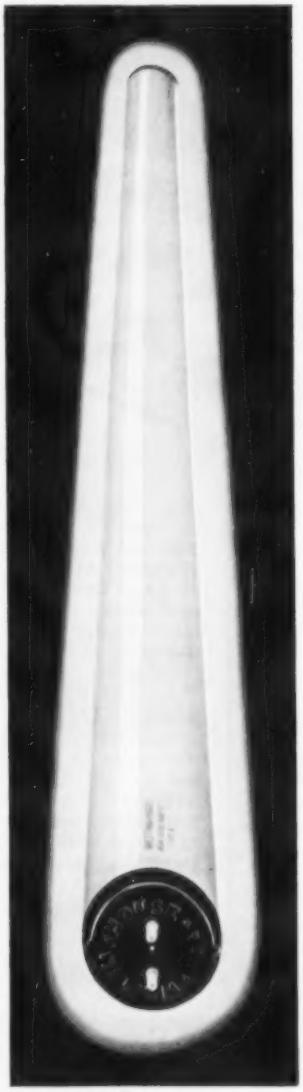
...all with ULTRALUME™ High-Intensity Phosphors • MORE LUMENS PER WATT... more light for your dollar • UNIFORM END-TO END LIGHT • PERFECT COLOR MATCH...ALWAYS • MAXIMUM OUTPUT MAINTAINED THROUGHOUT LONG LIFE

1. New SUPER-HI Fluorescent lamps produce more than twice the light per foot. Designed primarily for high bay (20 feet or higher) industrial and outdoor lighting, a new line of extra high light output fluorescent lamps produce more than twice as much light output per foot as standard fluorescent lamps. The new SUPER-HI lamps permit extremely high energy loading of electrodes, the arc stream and the phosphor. This gives you high light output with new economy at good efficiency and long life.

SUPER-HI lamps are light in weight, convenient to handle and provide a light source subject to the same easy optical control as with present standard T12 lamps, but with over twice the light output. Available in 105, 155, and 205 watts, 4, 6 and 8 ft. The lamps have a rated average useful life of 5000 hours, deliver 6000 to 13,000 initial lumens.

2. High Output Rapid Start lamps give more than 50% more light than regular type. Designed primarily for medium-high bay (15 to 20 feet) industrial and outdoor lighting, four new sizes of Westinghouse high output, rapid start fluorescent lamps can produce over 50% more light than comparable sizes of regular lamps and offer new economy and effectiveness to fluorescent lighting. These lamps provide increased lighting levels, make installations with adequate footcandle values of deluxe color light more practical, and improve the economy and practicability of fluorescent lighting at higher mountings and at lower ambient temperatures.

These lamps are available in 24", 48", 72" and 96" T12 design for general indoor use and for outdoor service where retention of light output at low temperatures is essential. The 72" T12 is recommended for street lighting.



3. Reflector-Fluorescent lamps produce 60% more directed light. For use where external reflectors are difficult or impractical to use, or where dirt deposit cuts lighting effectiveness, these Westinghouse Reflector-Fluorescent lamps provide a directional light distribution which helps put the light where you want it. This is accomplished by a built-in reflecting surface, extending the length of the lamp on the inside of the tube, which redirects about 60% extra light out the other side. Westinghouse Reflector-Fluorescent lamps are recommended for use in coves, showcases and other locations where space is limited. Indirect lighting effects may also be obtained by aiming the lamps toward the ceiling.

They also solve special lighting problems including temporary lighting for construction projects, displays, and exhibits.

Westinghouse Reflector-Fluorescent lamps are available in 40 watt rapid start, 48" and 96" T12 slimline types.

4. Beauty Tone™ Home-line Fluorescent lamps with warm white deluxe color. The same new Westinghouse "Beauty Tone Home-line" lamps which are revolutionizing home lighting by providing warm white deluxe illumination are also ideal for offices, stores and wherever "friendly" color of light is wanted to flatter complexion, enhance the natural color of furnishings, decorations, and displays, and blend well with incandescent lighting.

There's a network of Westinghouse distributors ready to serve you. Call your nearest Westinghouse Supplier for a free Job-Tailored Survey of your lighting requirements. Or write Westinghouse Lamp Division, Bloomfield, N. J.

YOU CAN BE SURE...IF IT'S Westinghouse

has an inside coating

of ***ALUMINUM ENAMEL***

for easier fishing

XDUCT RIGID STEEL CONDUIT listed by UNDERWRITERS' LABORATORIES, INC.

National Electric Products

PITTSBURGH, PA.

2 Plants • 12 Warehouses • 41 Sales Offices

in the long run... it's O.Z.

Type AX

Provides 4" expansion, contraction movement. Malleable iron head, body Hot Dip Galvanized. Weathertight head sealed by factory-installed high grade graphite packing. Insulating conduit end bushing eliminates cable abrasion. 10 sizes for conduit ½" to 4" diameters.

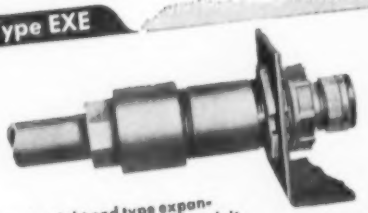
Type EX

Permits 8" conduit movement. Optional length sleeves, additional cost. Weathertight head sealed by factory-installed high grade graphite packing. Insulating bushings prevent cable abrasion. Hot Dip Galvanized finish. 13 sizes for ½" to 6" conduit diameters.

Type EXDS

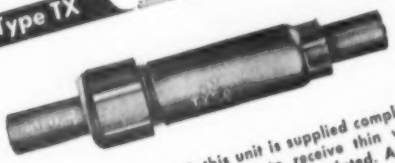
Compensates for deflection, expansion, contraction. ¾" movement all directions from normal; 30° angular movement. Also used as vibration damper between conduit sections. 10 sizes.

Type EXE



Weathertight end type expansion fitting. Designed for conduit terminating in junction box, where expansion, contraction take place. Supplied complete: locknuts, bushings. Standard finish, Hot Dip Galvanized. 13 sizes.

Type TX



Similar to the Type AX, this unit is supplied complete with extension nipples, ready to receive thin wall couplings. Standard finish is cadmium plated. Available in 6 sizes for conduit ranging from ½" to 2".

for the longer line of EXPANSION FITTINGS

In the long run, no line of conduit is more dependable than its components. When it comes to dependability in expansion fittings, look to O. Z. as the line that measures up! Five basic types provide the dependable answer to your fitting problems in conduit expansion, contraction, and deflection. O. Z. is the dependable line because it's the line with the *right size*, the *right type*, for every requirement!

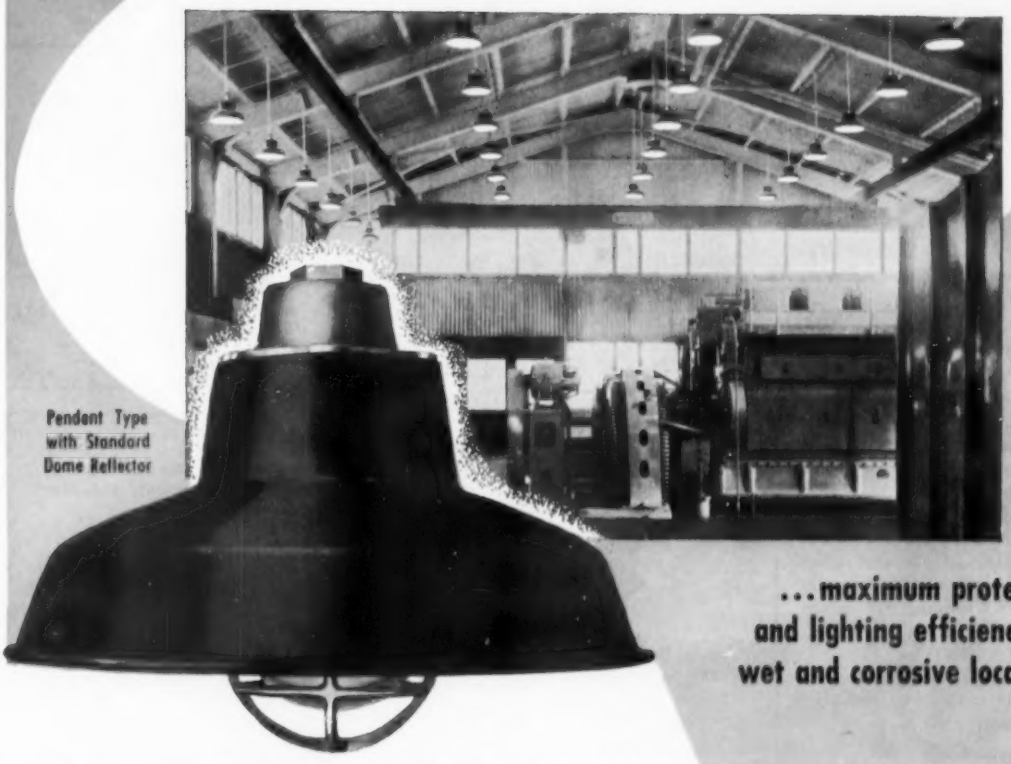
O.Z. ELECTRICAL MANUFACTURING CO., INC.

262 BOND STREET • BROOKLYN 17, N. Y.

- CAST IRON BOXES
- CABLE TERMINATORS
- POWER CONNECTORS
- SOLDERLESS CONNECTORS
- GROUNDING DEVICES
- CONDUIT FITTINGS
- INTERLOCKED ARMOR CABLE FITTINGS

Sales Office and Warehouse: 406 So. Cicero Avenue, Chicago 44, Ill. • ESterbrook 9-0326
Office and Factory: 749 Bryant Street, San Francisco 7, Calif. • GArfield 1-7846

R&S VAPORTIGHT *Lighting Fixtures*



Pendant Type with Standard Dome Reflector

...maximum protection and lighting efficiency for wet and corrosive locations

For outstanding vaportight and raintight protection, specify R&S Vaportight lighting fixtures. They're designed for outdoor or indoor use, wherever moisture, vapors, smoke, non-hazardous gases or corrosive atmospheres are present. Outdoor locations include: docks, loading platforms, airports, underpasses, bridges, building entrances, and many others. Indoor applications range from cold storage plants, breweries, dairies, boiler rooms, power houses, tunnels, to shower rooms and bathhouses.

The simplified design of these quality fixtures assures superior illumination with minimum installation, service and operating expense. The fixtures are available in a wide range of ceiling, pendent and bracket types — in 15 watt through 500 watt sizes. Bases have wiring chambers that stay vaportight even when globes are removed or broken. All guards and globes are interchangeable in their respective sizes.

WRITE FOR BULLETIN 2A - 4

R&S also makes Explosion-Proof, Dust-Tight and Marine Lighting Fixtures and Fittings

A Complete Line for Every Lighting Need

Pendant Type without reflector | Ceiling Type with Shallow Dome reflector | Bracket Type without reflector | Pendant Type with 30° Angle reflector

RUSSELL & STOLL COMPANY, INC. • 125 BARCLAY STREET, NEW YORK 7, N.Y. D-20

RUSSELL & STOLL

PRECISION-BUILT ELECTRICAL EQUIPMENT—SINCE 1907

How to select a Remote Control Switch

Electrical engineers are increasingly incorporating Remote Control Switches into their wiring layouts and circuits. Remotes today are used not only for the instantaneous control of emergency equipment, where they are a *must*, but for safety, economy and convenience wherever light or power is being distributed over a wide area.

Selection of Type

The selection of the right remote for a particular application must be given some study, but basically there are only two factors which affect the selection of type: (1) the class of load: non-inductive, such as heaters and lighting; or inductive, such as motors; (2) the voltages of the systems used.

Mixed Loads

Where there are mixed loads, non-inductive load rating must not be less than the combined full-load currents nor less than 66⅔% of the maximum current to be interrupted.

Any connected motors should be evaluated on the basis of stalled rotor current, using the multiplier of six times motor current if the actual value is not known. These currents added to the non-inductive load current will establish the maximum current which the switch will have to interrupt. In specifying the switch capacity, give class of the load and the amount of the load which is to be controlled.

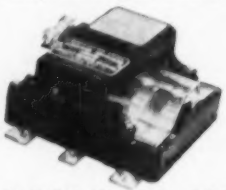
Why Mechanically Held

Another important selection-factor is that the remote control switch be mechanically held. Because it is essentially a feeder disconnect, the remote must be unaffected by line voltage conditions and respond only to control of the push buttons. ASCO mechanically held remotes insure against outages on vital circuits caused by momentary line voltage dips.

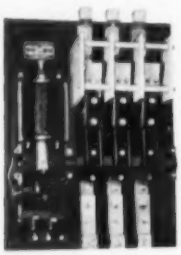
A detailed report on the advantages of ASCO remote control switches can be obtained by writing for new catalog 57-S2.

A selection of basic Remote Control Switches by ASCO

For Economy and Rugged Construction . . .



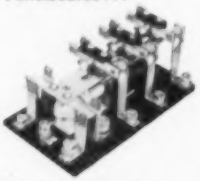
Use the Bulletin 920 — Up to 3 Poles, Single Throw, 30-75 Amps D-C, 30-200 Amps A-C. U.L. Approved to 600V A-C, 250V D-C. Recommended for all loads within its capacity range.



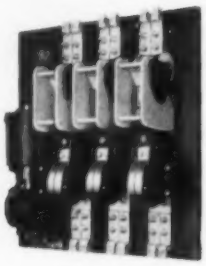
For Load Requirements Exceeding Capacity of the Bulletin 920 . . .

Use the Bulletin 910—Up to 4 Poles, Single Throw, 30-400 Amps, 250 volts, A-C.

For Small Panelboards . . .



Use the Bulletin 909 — Up to 5 Poles, Single Throw, 3 Poles, Double Throw, 30 Amps, 250 volts, A-C or D-C.

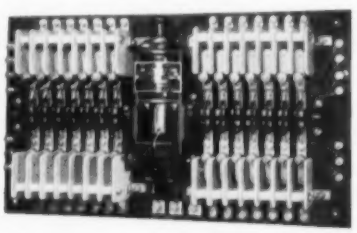


For High Capacity, Highly Inductive Loads . . .

Use the Bulletin 911—Up to 4 Poles, Single Throw, 30-1000 Amps, 600 volts, A-C, 250 volts, D-C.

For Multiple Pole Requirements . . .

Use the Bulletin 915—Up to 24 Poles, Single or Double Throw, 30, 60 and 100 Amps, A-C.



ASCO®

Automatic Switch Co.

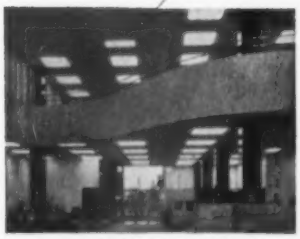
50-J Hanover Road, Florham Park, New Jersey

FRontier 7-4600

SCENE: THE COUNTRY OVER

"Tough-Nut" Illumination Problems Solved by Sunbeam Lighting!

with Sunbeam Lighting's DV3600-M 2' x 4' Visionaires, recessed in suspended ceiling. For high level, comfortable illumination.



with Sunbeam Lighting's HSDP3800 4' x 4' large area, recessed, Plexiglas shielded units. Architecturally integrated to enhance interior decor.

multi level commercial garage with Sunbeam Lighting's 1901 Series open type "antenna guard" Visionaires. Staggered pattern installed for optimum general illumination.

with Sunbeam Lighting's HL3800 Series, large area, louvered, recessed Visionaires. High intensity, low brightness illumination. Balanced—for merchandise sales appeal.

with Sunbeam Lighting's 1100 Series, all-metal, luminous indirect, minimum maintenance Visionaire. For demanding visual tasks.

Want the Full Story? Request Bulletins ZZ-10/1.

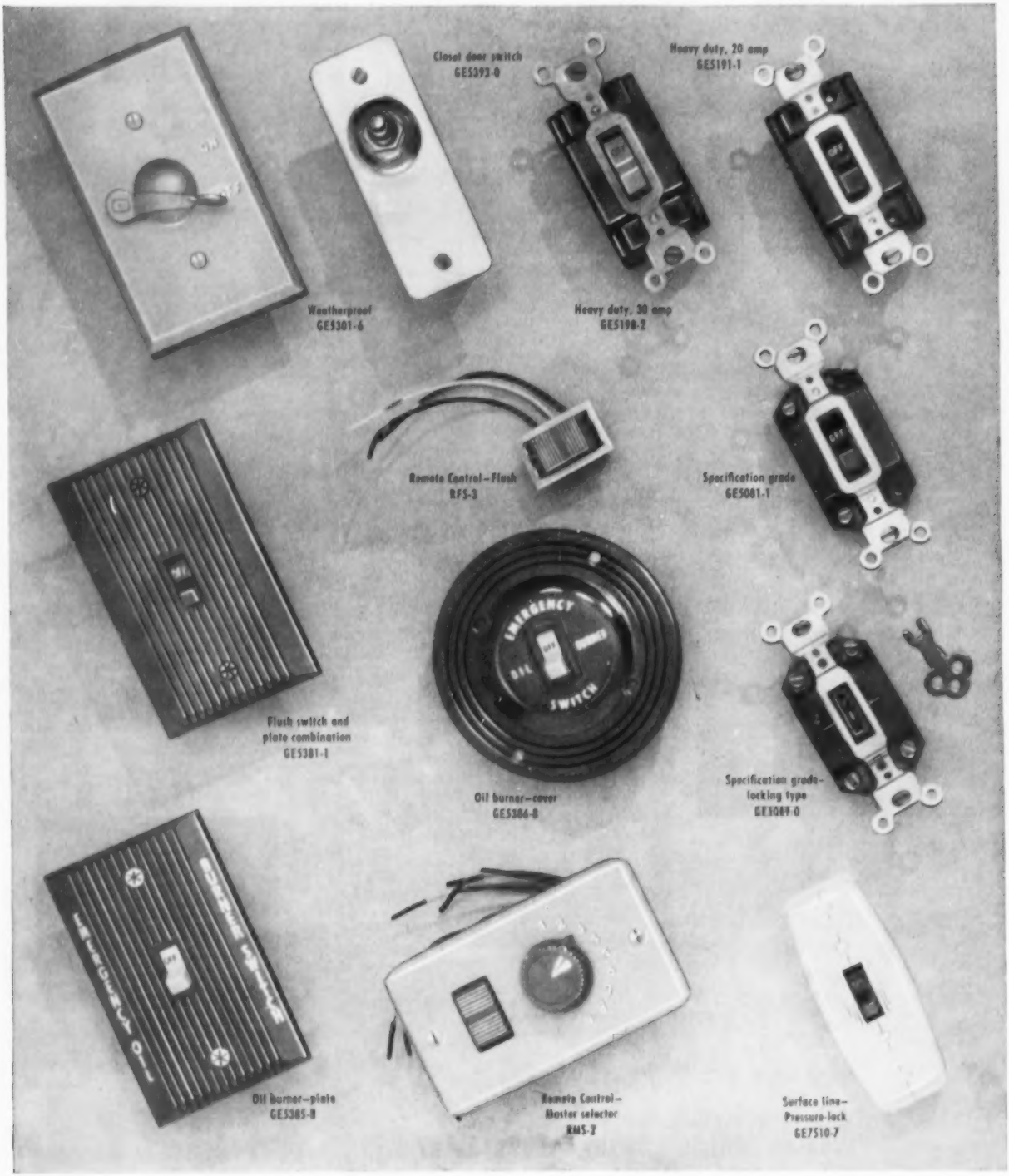
SUNBEAM visionaire LIGHTING COMPANY

SUNBEAM LIGHTING COMPANY, 777 EAST FOURTEENTH PLACE, LOS ANGELES 21, CALIFORNIA

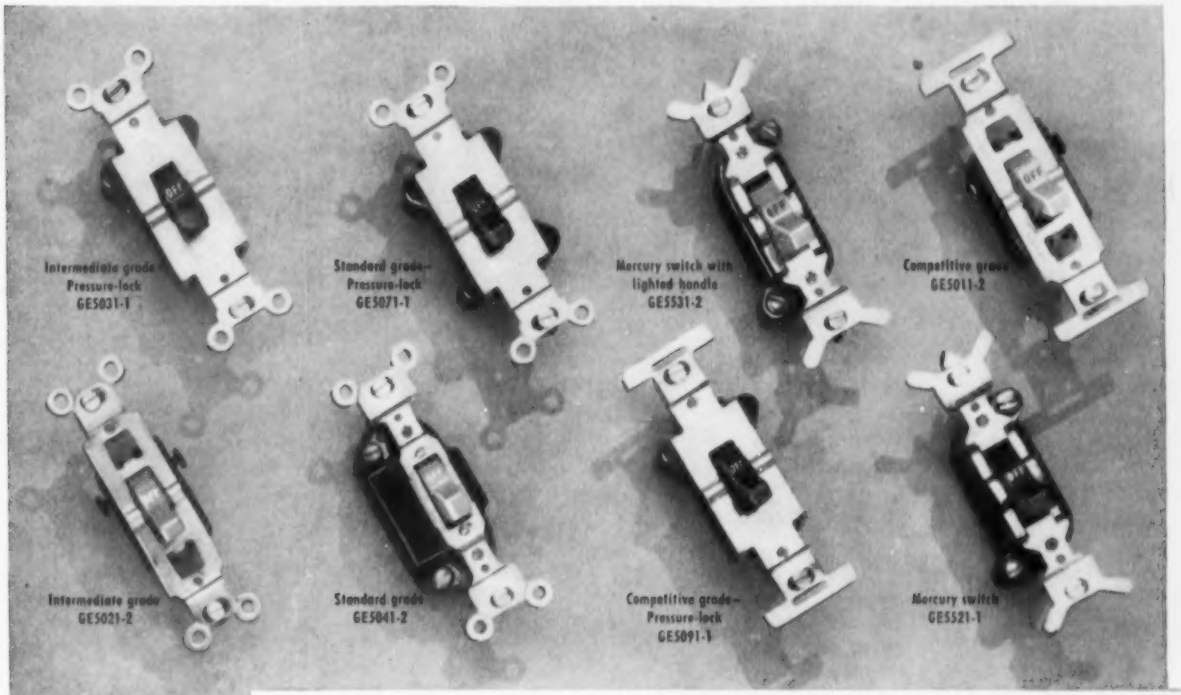
SUNBEAM LIGHTING CO., INC., 3840 GEORGIA STREET, GARY, INDIANA

BETTER LIGHTING FOR BETTER VISION WITH VISIONAIRE LIGHTING FIXTURES

The complete line of General Electric Switches



helps you make a full profit on every kind of job



For your next job, select from the more-than-150 switches made by G.E.

General Electric makes more than 150 different switches in order that you can choose one with exactly the right features and the right price for every job you do. Secondly, General Electric has built into these switches a number of advantages that make your installations faster and more profitable—advantages like pressure-lock terminals and 7/8" plaster-cleaning mounting screws. And G.E. doesn't leave the screws loose in the carton; they are held in the switch strap by fiber washers, ready for mounting. Third, General Electric "extras"—like lighted-handle mercury switches and remote-control switching—give alert contractors a chance to upgrade those jobs where plus features are equally as important as price.

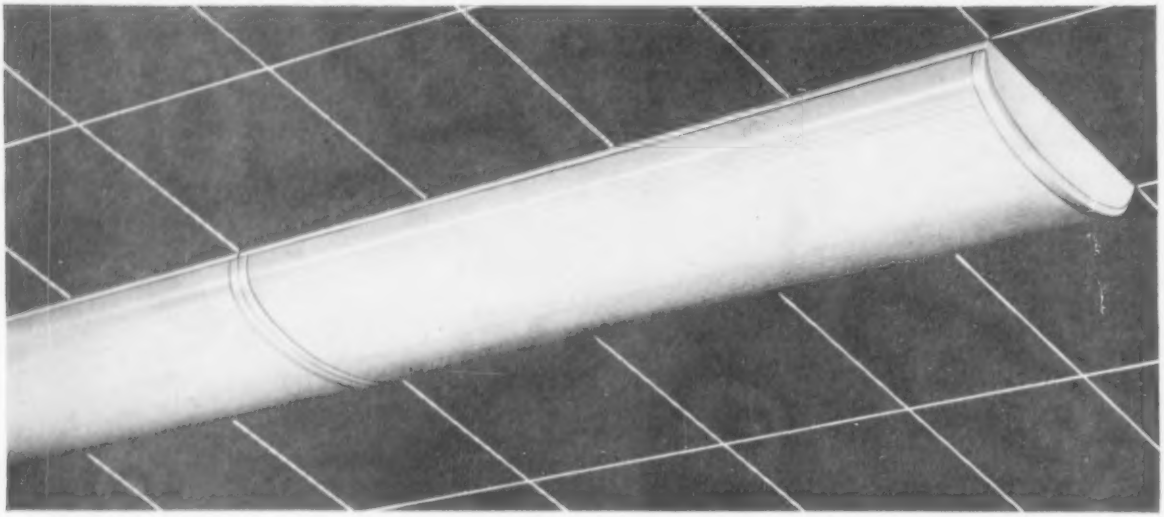
Ask your nearest General Electric distributor to demonstrate and tell you more about the complete line of competitively-priced, time-saving, dependable General Electric switches. At prices he will quote, you'll see why it is more profitable to use General Electric switches on your next wiring job. General Electric Company, Wiring Device Department, Providence 7, Rhode Island.

Progress Is Our Most Important Product

GENERAL ELECTRIC

"Built-In" look...

Surface-Mounted Cost



GARCY **Ultra-Lux** . . . shallow, plastic enclosed fixture . . . ideal for low ceiling lighting

Minimum depth consistent with good light distribution and brightness control

With curved shield, unit is only 3¼" at its deepest point . . . yet surface brightness is virtually uniform at all viewing angles and well within acceptable limits for glare-free comfort.

Improved light-stable extruded plastic guaranteed not to warp or discolor

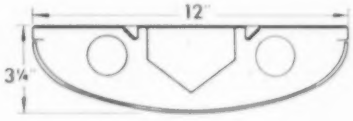
Shield is of Koppers improved EVENGLO*, a premium-grade polystyrene with built-in resistance to discoloration caused by ultra-violet radiation of fluorescent lamps.

Easy to install . . . only two basic parts

Completely assembled chassis with integral end plates is lightweight, sturdy, easy to handle. Separately cartoned one-piece shield hooks on after installation.

Easily cleaned . . . no need to remove shield from fixture

Curved shield is invisibly framed and hinged . . . lets down at a touch, wipes clean in seconds.

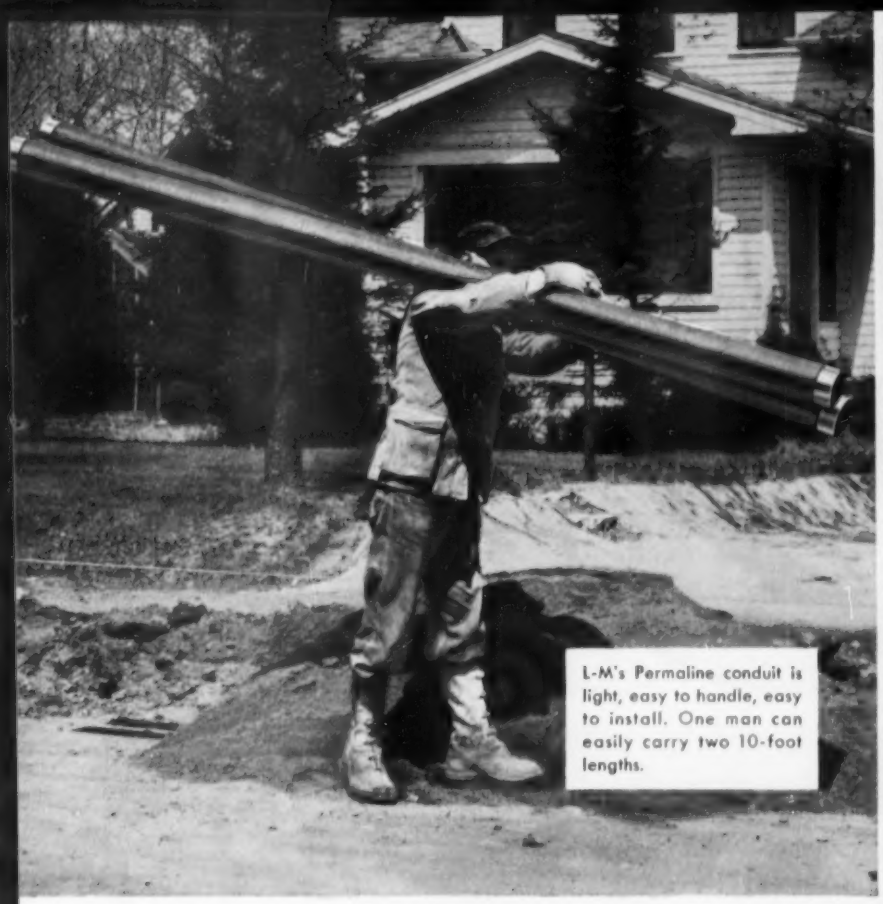


**EVENGLO is a registered trade mark of Koppers Company, Inc.*

GARCY
Preferred for Performance
COMPLETE COMMERCIAL LIGHTING

Garcy offers a complete line of lighting fixtures for commercial, institutional and display lighting.

Garden City Plating and Manufacturing Company
2475 Elston Avenue • Chicago 47, Illinois
In Canada: Garcy of Canada, Ltd., 1244 Dufferin Street, Toronto 4



L-M's Permaline conduit is light, easy to handle, easy to install. One man can easily carry two 10-foot lengths.

L-M's extra-long 10-foot lengths of Permaline conduit speed installation. Simply tapping the tapered coupling onto the tapered end of the conduit makes a strong, watertight joint—no caulking needed.

Saves Time and Labor...

Contractor Eliminates 13,750 Joints

With Long 10-foot Lengths of L-M Permaline Conduit!

Now, with L-M's exclusive 10-foot lengths of Permaline fibre conduit, you can eliminate 20% to 50% of the joints to be made on a job, and thus cut costly construction time and labor.

On one job requiring 550,000 feet of conduit, the contractor eliminated 13,750 joints by using L-M's long 10-foot lengths as compared with 8-foot lengths.

It will pay you to use L-M's time- and labor-saving 10-foot lengths of Permaline conduit for your next duct job. Only L-M Permaline is available in these 10-foot lengths.

Easy to Install

L-M lightweight Permaline fibre conduit is also easy to install. Joints are quickly made by simply tapping the tapered coupling onto the tapered end of the conduit. Joints are watertight and safe from seepage. Smooth bore reduces cable sheath abrasion. Completely engineered system for installation includes full line of bends, bell ends, couplings, and base and intermediate spacers.

L-M Permaline fibre conduit comes in 5, 8 and 10-foot lengths. Available diameters include 2, 3, 3½, 4, 4½, 5 and 6-inch sizes.

Get Complete Information

Ask the L-M Field Engineer for a copy of the 12-point plan folder which shows how easy it is to use the Permaline system; or Fibre Conduit Bulletin UG1A, which gives complete specifications. Or write Line Material Industries, Milwaukee 1, Wisconsin.

310

LINE MATERIAL Industries

McGRAW-EDISON COMPANY

McGRAW EDISON

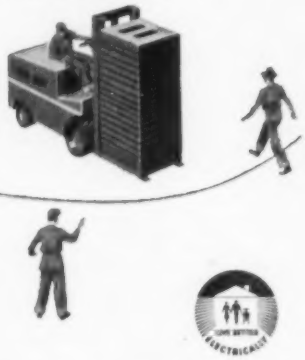
Permaline Fibre Conduit

BPI

This seal is your guarantee of recognized quality in Bituminous Fibre Conduit.

They Don't tread on me...

Avoid in-plant accidents with Diamond Type MD (Mill Duty) RED-D-PRENE®... its entire jacket in industrial red commands attention, while color coding facilitates correct wiring hookup.



Red "D"® Portable Cord

With Built-in PM*

* Plant maintenance men know maintenance costs are reflected in the plant manager's budget as production costs . . . so they always look for ways to reduce these costs. Here's your chance to help your industrial customers. Next time they have portable cord applications, send DIAMOND with built-in PM (Preventive Maintenance). Tell them Diamond's tough, oil and abrasion resistant sheaths give longer wear, better moisture protection, and provide maximum flexibility. Emphasize that they are available in jet black and the new Type MD (Mill Duty) RED-D-PRENE®, all conveniently marked to measure. They'll thank you for it.

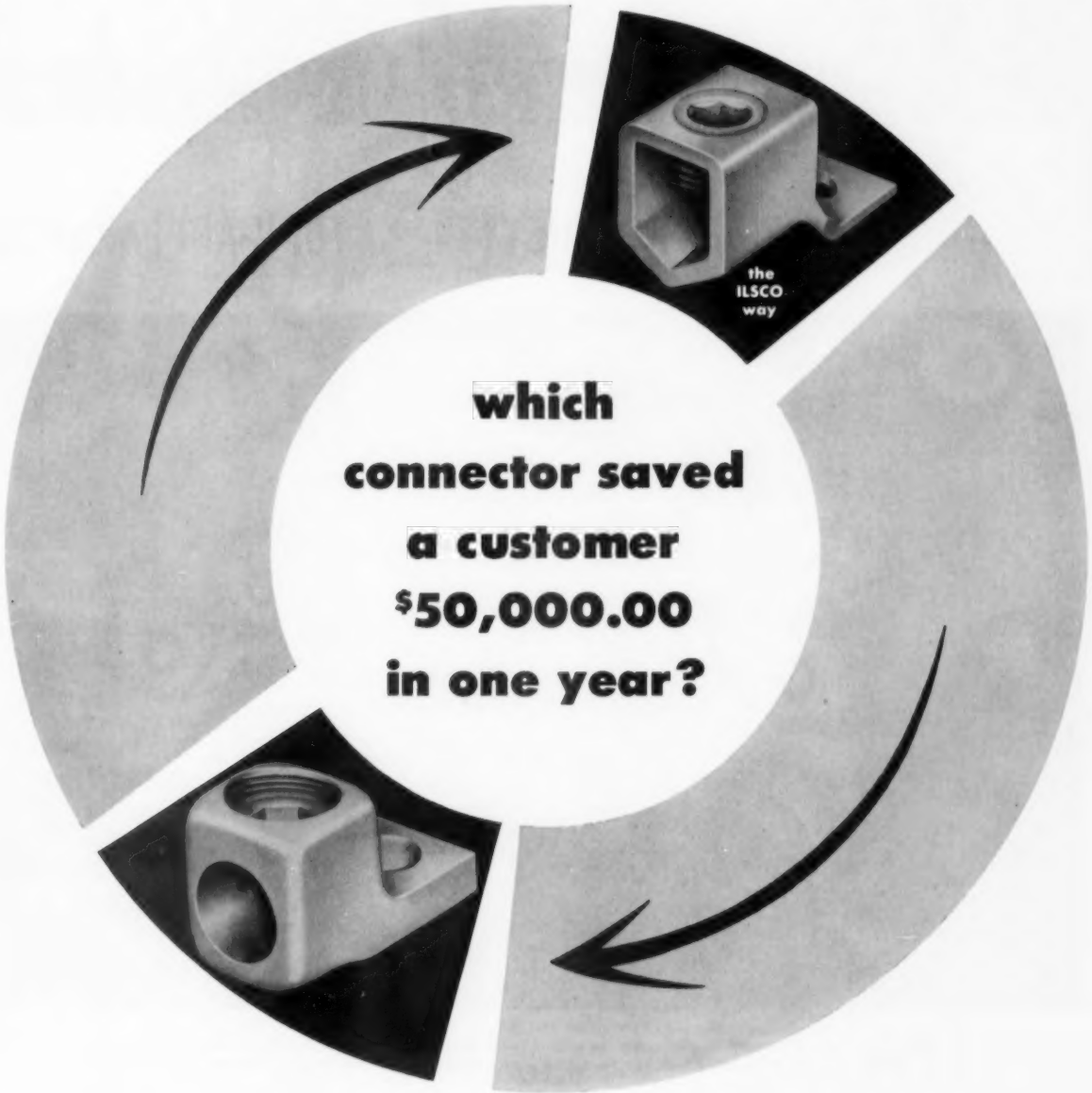
Diamond DTX® Non-Metallic WHITE Sheathed Cable. Non-sticking, smooth and easy to pull. Clean to handle, does not flake off!

Trade Mark ®

DIAMOND

WIRE and **CABLE** Company

Sycamore, Illinois



The connector designed and made "the Ilsco way"! And it's a fact. One of our customers actually saved $50,000 in one year through Ilsco's exclusive seamless tube construction method on this particular lug. This tremendous saving was realized because the Ilsco lug is smaller, stronger, lighter . . . requires less material and therefore is lower in price.

All Ilsco connectors are made of 100% pure electrolytic seamless copper guaranteeing maximum conductivity and low heat rise. Each is compact, light weight and will withstand hard usage and abuse. All are U/L and CSA tested. Copper is cold worked to retain its natural qualities.

Our engineering staff is ready and willing to work with you on your specific replacement or development problems.

For your free copy of Catalog #50 and samples, write Dept. C-10

CONNECTORS • FABRICATED TUBES • NEUTRAL BARS

SOLDERING LUGS • STAMPINGS • TERMINAL BLOCKS
SHADING COILS • WIRE-REINFORCED FUSE CLIPS

ILSCO
CORPORATION
4730 Madison Road • Cincinnati 27, Ohio U.S.A.
Ilsco of Canada, Ltd., 25 Carson St., Toronto, Ontario

MAINLINER LUMINAIRES

1 WIDEST VARIETY 2 "TOP" APPEARANCE

Lighting that *often* increases retail departmental sales as much as 300% is provided by Mainliner Luminaires, and featured *throughout* all departments of the great new Montgomery Ward store located at Portsmouth, Ohio.

Mainliner Luminaires, all, are simple to mount in continuous rows. Fixtures, as shown here, are merely butted, and then bolted together through the abundant knockouts. No connectors are necessary. These are Tee-Bar units.

Mainliner special reinforcement makes handling "firm" and easy. Dimensional correctness keeps installations perfectly "square," with no need for "readjustment!" 4'x 4' units, here, rest on Tee-Bars, need no added support!

LIGHT WARD'S NEW PORTSMOUTH STORE

3 SPEED, EASE, LOW COST OF INSTALLATION!

Mainliners—the industry's newest and most advanced luminaires—by Westinghouse—as in the new Montgomery Ward's store--are proving first choice of architects, lighting engineers and contractors alike!

Specification of Mainliners, by top professional men in the building industry, is due to Mainliner superiority on three specific counts: (1) Widest selection available in the industry! (2) Highest quality appearance! (3) Engineering, design and construction that *save installation costs three ways!*

Mainliner Widest Variety! 4 mounting types, 6 basic sizes and 13 shielding styles fulfill *any* large-area lighting requirement!—permit more than 1000 *all different* combinations! Modular proportions and *dimensionally correct* construction, of Mainliner Luminaires, "mate" with any type of "squared" ceiling material!

Highest Quality Appearance: Mainliner door-frames have *mitered* corners! Latches are flush, almost indiscernible. The extremely "shallow" design of Mainliner units gives a "patterned" rather than a "boxy" appearance, when they are surface-mounted. And, a black stripe applied to the light-trap seat—*eliminates* the escape of light from around the door-frames of Mainliner Luminaires!

Save Installation Costs 3 Ways! Rugged and reinforced Mainliner construction eliminates "crimping" and "wobbling"—for *much* easier handling! Mainliners come *completely pre-assembled!* Doors are packed separately. Cartons simply "rip" open. Mainliners cut *all* job-planning—job-layout—and luminaire-handling time!

Mainliners are only 4⅞" deep! Easiest ever to position and mount! Recessed models include Flange-type, Grid-type and Snap-in Tee-Bar units. Surface-mounted units permit a semi-recessed appearance.

Mainliner doors, too, come pre-assembled—hinge and latch from either side. And, the *complete pre-wiring* of Mainliner Luminaires is *consistently* reported to *cut wiring-time in half!*

Get *all three* superior advantages of Mainliner Luminaires—through your near-by Westinghouse Representative—or through your own, local Westinghouse Distributor! J-04426-R

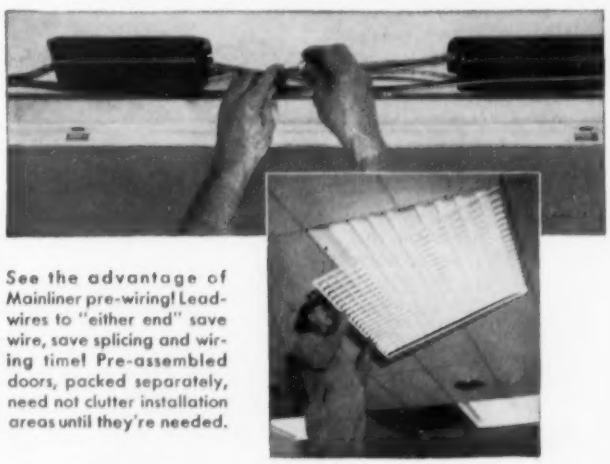
LIGHTING SALES CLINIC — Certified Lighting for a Better America

Request a Mainliner presentation today!

YOU CAN BE SURE...IF IT'S

Westinghouse

See how easily various models from the wide variety of Mainliner Luminaires are applied for both functional and decorative lighting, *as well as* for "Merchandising" lighting, at the new Montgomery Ward store in Portsmouth.



See the advantage of Mainliner pre-wiring! Lead-wires to "either end" save wire, save splicing and wiring time! Pre-assembled doors, packed separately, need not clutter installation areas until they're needed.

Along today's modern highways easy-to-handle J-M Transite Ducts provide installation economies and years of service life, protecting traffic-signal, lighting, and other power-service circuits.

J-M Transite® Ducts install fast to last... give complete cable protection.

Because speed and economy set the pace in today's highway programs, more and more highway cables are going into Johns-Manville Transite Ducts.

For speed, Johns-Manville Transite Ducts are strong, light and long—easy to handle and install. Workmen set 10-foot lengths in place easily, join them up tight in seconds with snug-fitting J-M Plastic Couplings, and Transite's smooth bore is free of burrs and other obstructions that may interfere or cause damage during pulling of cables.

For economy, J-M asbestos-cement Transite Ducts go in to stay. Non-conductive Transite is not affected by electrolysis—resists the corrosive action of fills or high-salt soils in permanently damp locations. Millions of feet of installed Transite Ducts have proved that Transite withstands earth loads and soil stress... resists vibration and shock from highway traffic.

Let us send you free Transite Duct brochure EL-29A. Write Johns-Manville, Box 14, New York 16, N. Y. In Canada, Port Credit, Ontario.

JOHNS-MANVILLE Transite Ducts

Made of Asbestos-Cement

J-M Conduit for direct buried banks and exposed runs
J-M Korduct® for concrete banks

Johns-Manville Asbestos Transite Ducts can be laid directly in trench without concrete envelope or other mechanical protection.

JEFFERSON
CONSTANT WATTAGE
INDOOR
MERCURY
LAMP
BALLASTS

CONSTANT WATTAGE GIVES YOU:

- *Constant light output*—maintained within ±2%, even if line voltage fluctuations reach ±13% . . . more ballasts per circuit . . . wide range of primary voltages eliminates need for primary taps.
- *Fewer failures*—Low extinguishing point minimizes outages due to voltage dips.
- *Longer lamp life*—with surges in line voltage not transmitted to bulb, shortened bulb life from this cause is eliminated.
- *Lower installation costs*—the current required for starting is less than normal, so fuses and breakers can be lower capacity, and wiring lighter—savings in installation and upkeep.

THE NEW *Jefferson* BALLASTS

With years of experience producing thousands of outdoor constant wattage transformers, Jefferson now makes available a new and complete line of indoor constant wattage ballasts for mercury lamp operation . . . another product of Jefferson advanced engineering skill.

construction features:

- These new ballasts are suitable for either wall or pendant mounting.
- Large, roomy double wiring compartments in all models makes installations fast and easy.
- ½" and ¾" knockouts on top, bottom, and sides of case.
- Easy-to-follow schematic diagram shown on the nameplate of each case.

HIGH POWER FACTOR CONSTANT WATTAGE BALLASTS

CATALOG NUMBER	LAMP WATTAGE	LAMP TYPE	LINE VOLTS	LINE AMPS	INPUT WATTS
237-261	100	H-4	100-130*	1.1	120
237-281	175	H-22	100-130*	1.85	205
237-871	250	H-5	100-130 200-260†	2.50 1.25	285
237-821	400	H-1	100-130 200-260†	4.00 2.00	445
237-901	(2) 400	(2) H-1	100-130 200-260†	7.60 3.80	870
237-761	700	H-18	100-130 200-260†	6.80 3.40	770
237-101	1000	H-12	THIS UNIT AVAILABLE JAN. 1, 1958		
237-111	1000	H-15	THIS UNIT AVAILABLE JAN. 1, 1958		

*Also available in the following ratings: 200-260, 240-315, 400-520

†Also available in the following ratings: 240-315, 400-520

Jefferson CONSTANT WATTAGE MERCURY LAMP BALLASTS

JEFFERSON ELECTRIC COMPANY • BELLWOOD, ILLINOIS

Bulletin L571-6.1 (new)

A new dimension in motors!

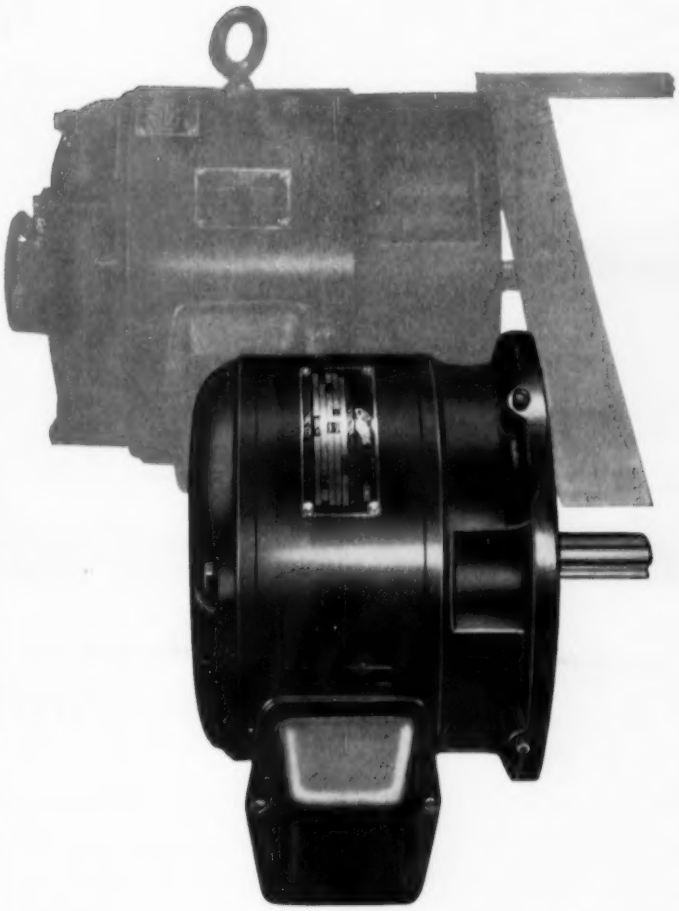
SHORTER Century Performance Rated® MOTORS

SAVE SPACE...
SAVE WEIGHT

This new line of shorter, round-frame, end-mounted motors by Century can give you greater freedom in design and engineering. They meet modern demands for compactness and weight-saving ... with even better performance.

No special mountings are required! These shorter Century motors have full-size NEMA "D" flanges. They are interchangeable with all other popular makes of standard end-mounted motors. The shorter motors are available in sizes from 1 to 15 H.P... in open or totally enclosed fan-cooled frames . . . for vertical or horizontal applications.

For full data, call your nearest Century Sales Office.



Performance Rated©
MOTORS
⅛ to 400 H. P.

CENTURY ELECTRIC COMPANY

1806 PINE ST., ST. LOUIS 3, MO. • *Offices and Stock Points in Principal Cities*

34

No "stuffed shirts" here!

Nor much sympathy either for "red tape" or routine handling of emergency orders.

From experience, Circle distributors know that when they need fast action on an order, they can get to anyone from the president on down . . . and receive immediate attention.

Happily, such emergencies don't occur too often for the simple reason that the ample stocks of Circle distributors are strongly supported by well-stocked nearby supply centers.

Thus any emergency order, as a rule, need go no further than the local warehouse.

All-out service . . . broad line . . . ample stocks: these are why more and more contractors agree that working through a Circle distributor is their best assurance of adequate, available supplies.

Circle Wire and Cable Corp., 5500 Maspeth Avenue, Maspeth, N. Y.

CIRCLE WIRE & CABLE
a subsidiary of
CERRO DE PASCO CORPORATION

PLANTS: Maspeth and Hicksville, N.Y. SALES OFFICES: In all principal cities

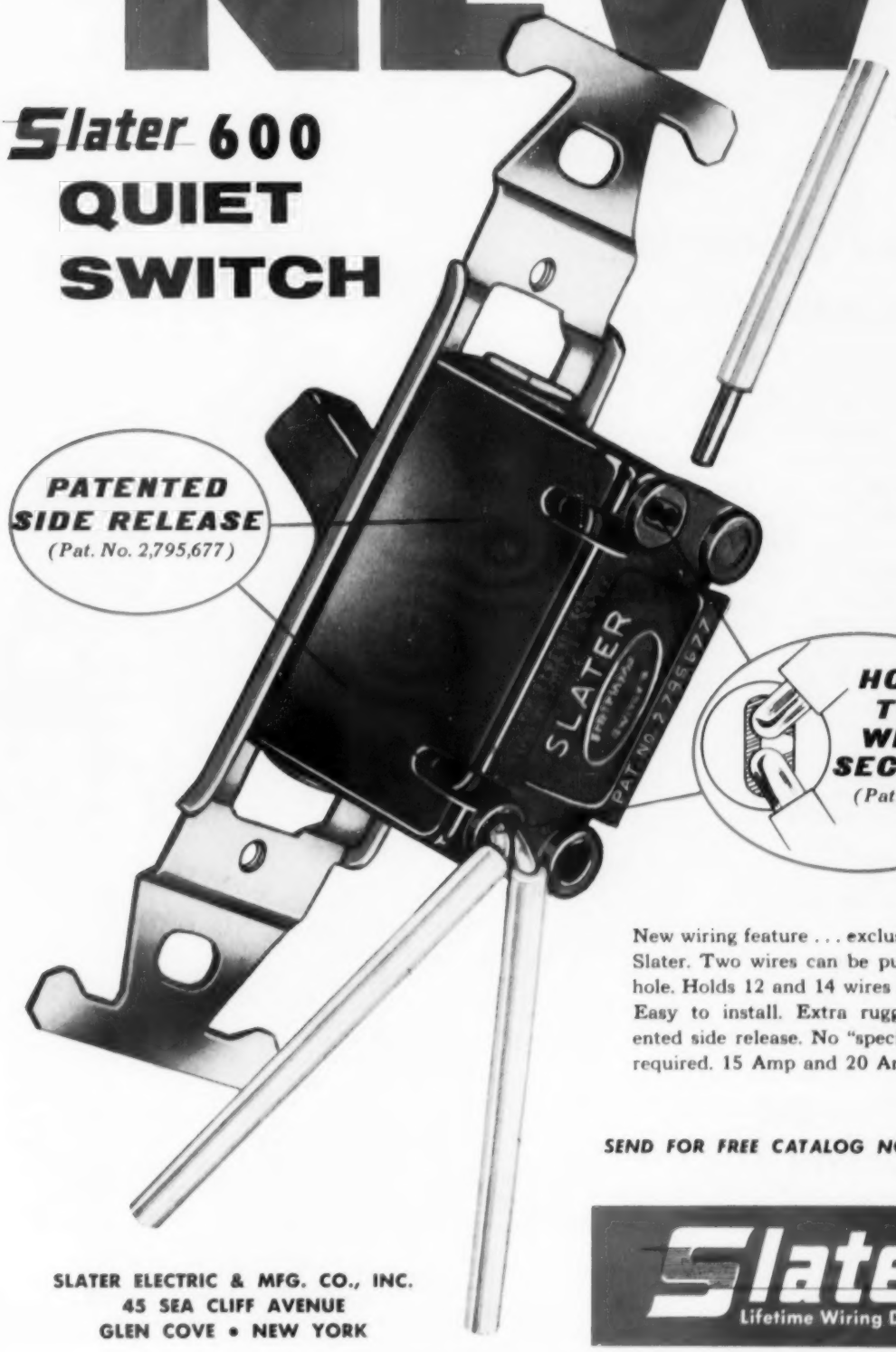
RUBBER COVERED WIRES & CABLES • VARNISHED CAMBRIC CABLES • PLASTIC INSULATED CABLES • NEOPRENE SHEATHED CABLES

New Wiring Calculator — FREE!

Send today for this useful wiring aid. Gives conduit sizes, amperage capacities, and motor running data. Write Dept. A10

NEW

Slater 600 QUIET SWITCH



PATENTED SIDE RELEASE
(Pat. No. 2,795,677)

HOLDS TWO WIRES SECURELY
(Pat. Pending)

New wiring feature . . . exclusive with Slater. Two wires can be put in each hole. Holds 12 and 14 wires securely. Easy to install. Extra rugged. Patented side release. No "special" tools required. 15 Amp and 20 Amp.

SEND FOR FREE CATALOG NO. 35 TODAY

SLATER ELECTRIC & MFG. CO., INC.
45 SEA CLIFF AVENUE
GLEN COVE • NEW YORK

Slater
Lifetime Wiring Devices

BE MODERN,

increase protection, buy Westinghouse

there was a time when a boxful of spaghetti wiring and a jumble of literally "shocking" fuse blocks was called a panelboard. Few folks still think there's a reason for such equipment.

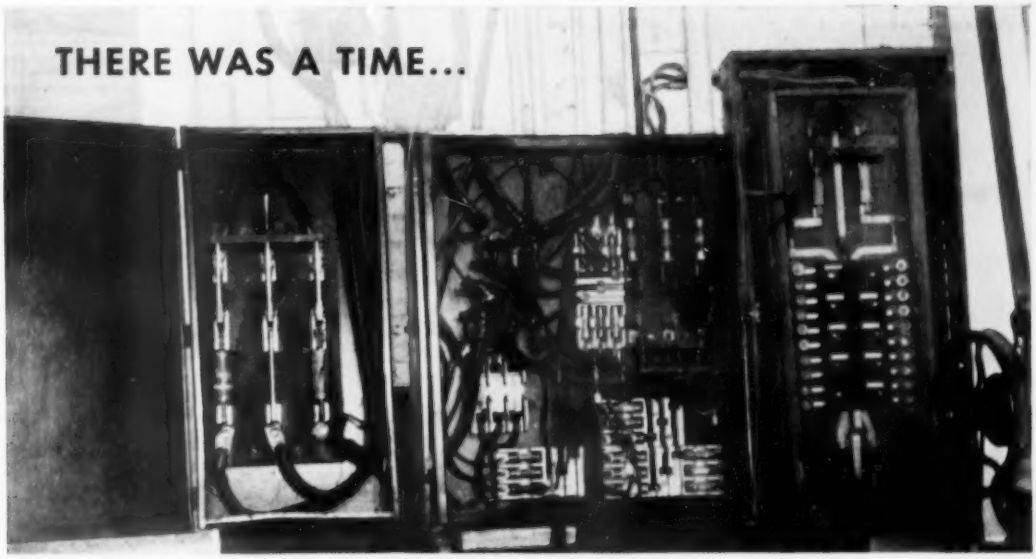
now, any distribution system involving the safety and continued productivity of people and plants calls for modern engineered panelboards and switchboards. A typical Westinghouse combination is shown at lower right... but there are ever so many other types, designed for everyone's needs. All are factory assembled—easy to install, convertible to infinite circuit combinations.

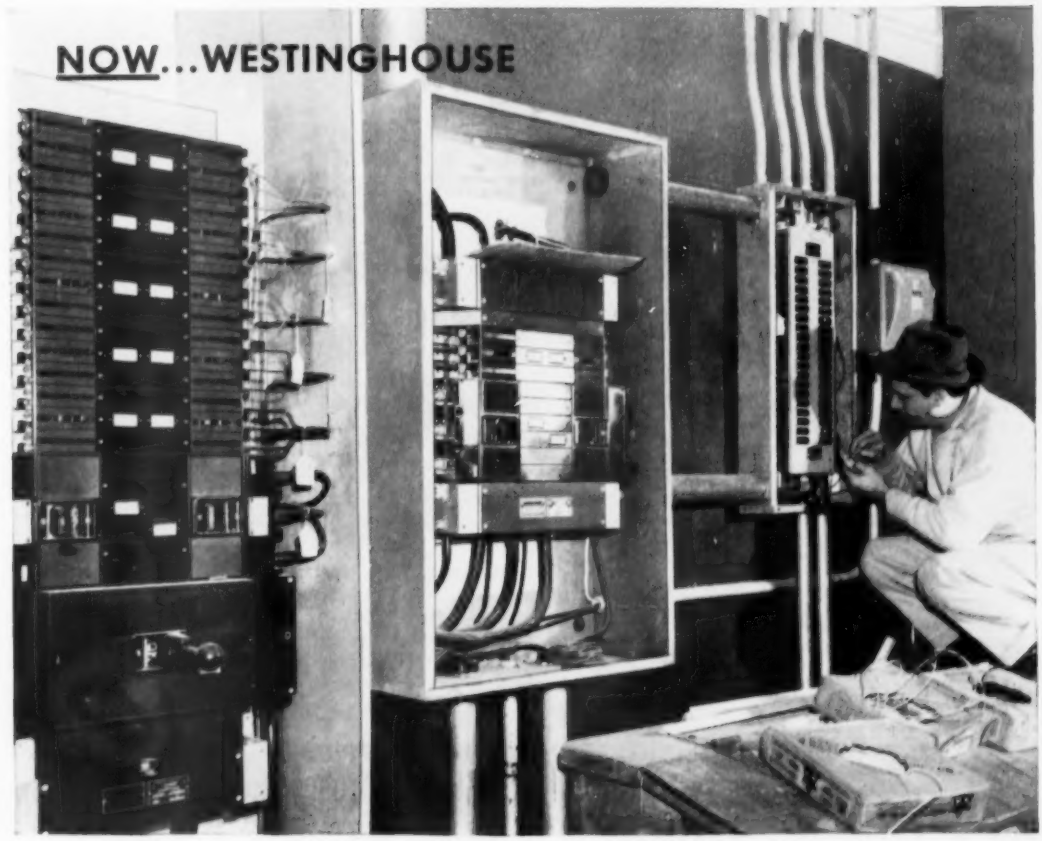
J-93535

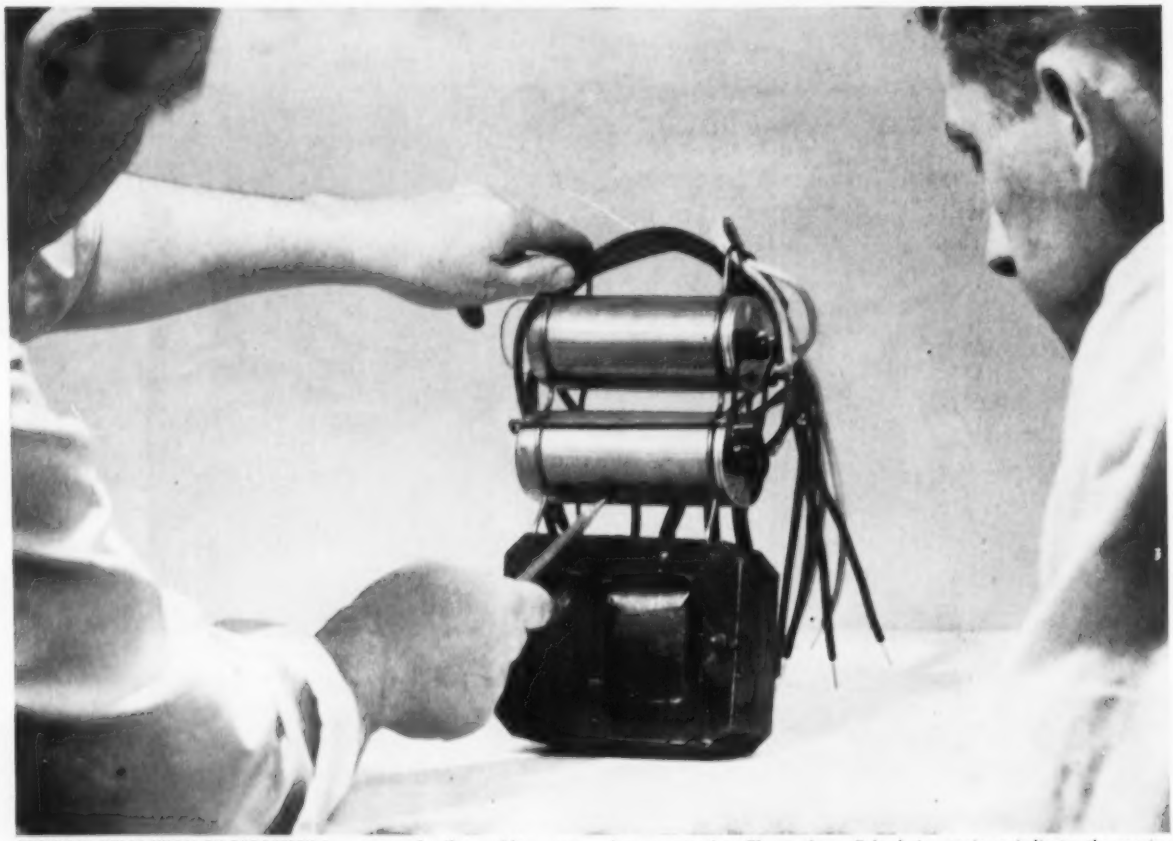
this book tells how to select the right panelboards to fit varying distribution problems. Write for your copy today. Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pennsylvania.

YOU CAN BE SURE...IF IT'S

Westinghouse


THERE WAS A TIME...


NOW...WESTINGHOUSE



PHYSICAL SEPARATION OF CAPACITOR *from core-and-coil assembly assures protection against capacitor failure due to heat arising from normal transformer operation. Shown above, Sola design engineer indicates the spacing of capacitors (top) from core-and-coil assembly in the Sola transformer.*

Design Feature Protects Capacitor Life in Sola Mercury Vapor Lamp Transformers

Capacitor failure is a major cause of malfunction of outdoor mercury vapor lamp transformers. Almost invariably, heat normally generated by transformer operation is responsible. Sola Constant Wattage Mercury Vapor Lamp Transformers are designed to protect against capacitor failures by providing safe physical separation of capacitor from the core-and-coil assembly.

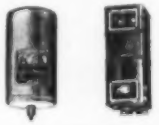
This design feature is indicative of the mechanical and electrical design caliber of Sola Constant Wattage Mercury Vapor Lamp Transformers. The result is superior performance, reliability, and reduced system maintenance cost for outdoor mercury vapor lighting.

Sola Constant Wattage Transformers offer unique electrical characteristics:

- Lamps remain lit even when line voltage dips as low as 75v on a 115v line.
- Energy to lamps is regulated within $\pm 2\%$ in spite of line voltage swings as great as $\pm 13\%$.
- Regulated voltage, current, and wattage permit continuous stable operation — extend lamp life.

When you're next concerned with design, specification or installation of outdoor mercury vapor lighting — shopping centers, parking lots, service stations, playfields, plant area protection — investigate the advantages of Sola Constant Wattage Mercury Vapor Lamp Transformers. Your Sola representative, listed below, will be happy to provide prompt attention to your inquiries.

SOLA *Mercury Vapor Lamp* **TRANSFORMERS**



Write for Bulletins 17J-MV-219 and 17J-MV-244

SOLA ELECTRIC CO.
4633 W. 16th Street
Chicago 50, Illinois

CONSTANT VOLTAGE TRANSFORMERS • LIGHTING TRANSFORMERS • CONSTANT VOLTAGE DC POWER SUPPLIES
SOLA ELECTRIC CO., 4633 West 16th Street, Chicago 50, Illinois, Bishop 2-1414 • BRANCH OFFICES: Boston, Mass.; Cleveland, Ohio; Kansas City, Mo.; Los Angeles, Calif.; New York, N. Y.; Philadelphia, Pa.; San Francisco, Calif.; Wallingford, Conn. • *Representatives in Other Principal Cities*
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New All-Purpose NON-GANGABLE SWITCH BOXES

YOU CAN ALWAYS RELY ON RACO

Use them in all locations
For Dry Walls! For Plaster Walls!

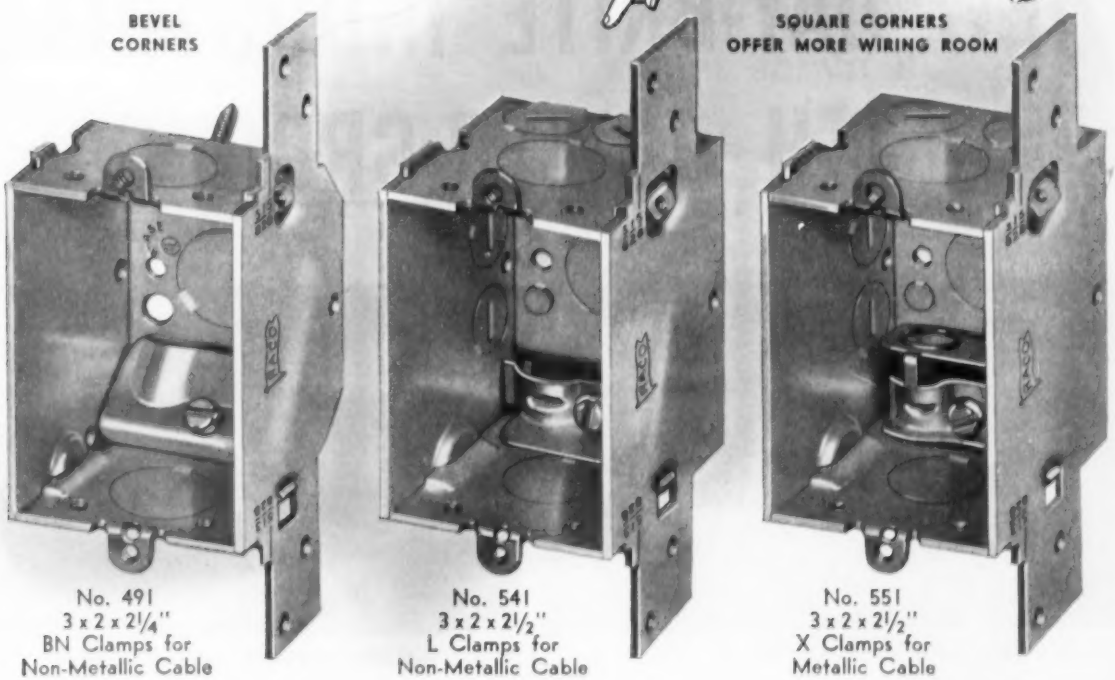
Quickly and easily installed. Gauge marks on bracket show proper position for 3/8", 1/2" and 5/8" wall thicknesses. Simply align marks with edge of stud and nail down.

VERSATILE BOXES... Ideal for Combination Wiring

No. 491 and No. 541 have clamps for non-metallic cable. No. 551 has metallic cable clamps. All have 1/2" KO's for entry of thin-wall (E.M.T.).

BEVEL CORNERS

SQUARE CORNERS OFFER MORE WIRING ROOM



No. 491
3 x 2 x 2 1/4"
BN Clamps for
Non-Metallic Cable

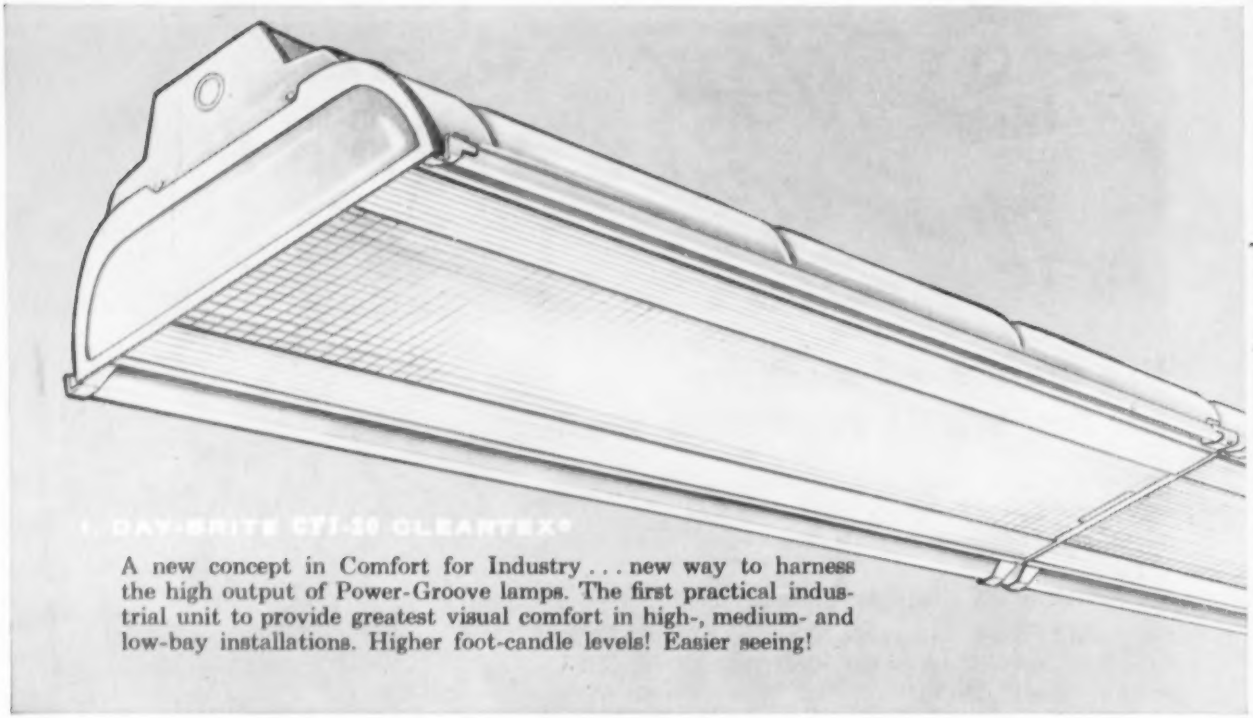
No. 541
3 x 2 x 2 1/2"
L Clamps for
Non-Metallic Cable

No. 551
3 x 2 x 2 1/2"
X Clamps for
Metallic Cable

"A RACO BOX FOR EVERY NEED"

ASE RACO

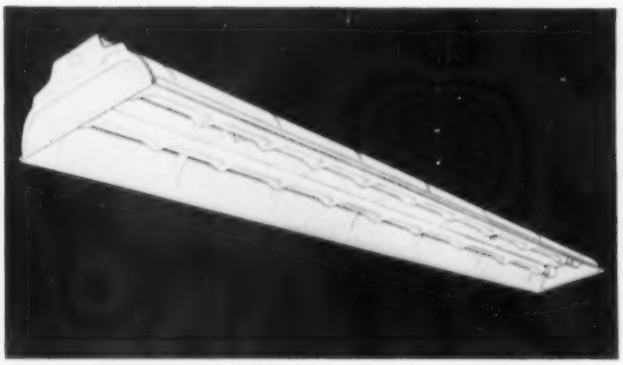
ALL-STEEL EQUIPMENT INC.
AURORA, ILLINOIS



1. DAY-BRITE CFI-30 CLEARTEX®

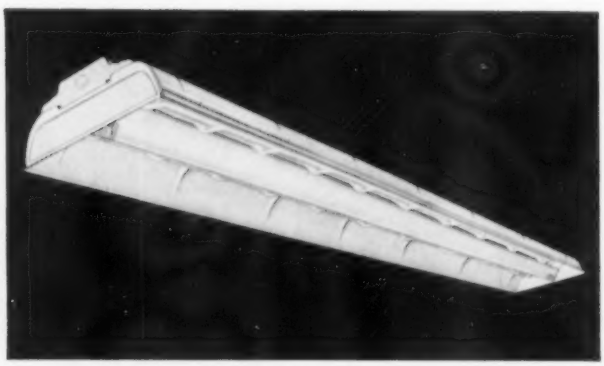
A new concept in Comfort for Industry . . . new way to harness the high output of Power-Groove lamps. The first practical industrial unit to provide greatest visual comfort in high-, medium- and low-bay installations. Higher foot-candle levels! Easier seeing!

NEW DAY-BRITE INDUSTRIALS WITH POWER-GROOVE!



2. Day-Brite CFI-15 *(15% uplighting)*

For medium and high-bay installations . . . higher foot-candles . . . Fluorescent comfort . . . lowest Fluorescent costs. Features lifetime porcelain enamel finish, embossed apertures, reinforcing ribs, closed ends. Hinged louvers available.



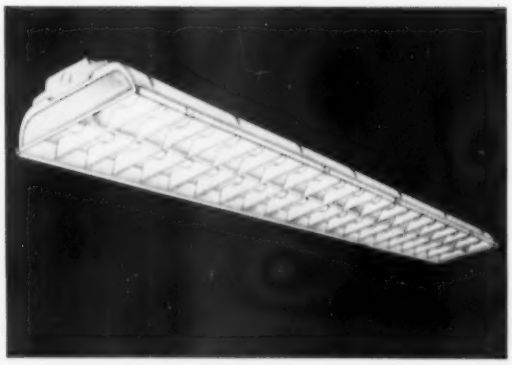
3. Day-Brite CFI-30 *(28% uplighting)*

Offers all the outstanding features of the CFI-15 plus greater shielding for greater comfort. For low, medium and high-bay applications.

NATION'S LARGEST MANUFACTURER OF COMMERCIAL AND INDUSTRIAL

Mr. Hilliard Travis, President of Travis Electric Company, Nashville, Tenn.

Here's the most important industrial lighting news since 1954! A complete new family of fixtures offering the latest developments in Day-Brite research ... more proof that Day-Brite keeps the lead in Comfort For Industry lighting! ... Look 'em over.



4. Day-Brite CFI-30L *(28% uplighting)*
Offers all the up-to-date features of the CFI-30 *plus louvers.*

"Best fixtures... best service"

"In dealing with Day-Brite, I find I not only get the best lighting fixtures made, but also the best service from the time the order is placed until it is installed.

"Day-Brite representatives really follow through and see that everything is shipped complete and in good shape. They also visit the job several times while it's in progress to see that everything is all right and offer helpful advice to make a better finished job.

"This kind of service doesn't show up in the cost column but it sure shows up in the profit column. I like Day-Brite's policy of following through on the job."

Mr. Travis speaks for contractors all over the country. How about you? Installed Day-Brite fixtures lately? Experienced helpful Day-Brite follow-through for yourself? Isn't it time you did?

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Lighting Fixtures

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On every wiring job where top-quality performance, expert workmanship and experienced "know-how" are called for, *it pays to rely on Phelps Dodge and your Phelps Dodge distributor!*

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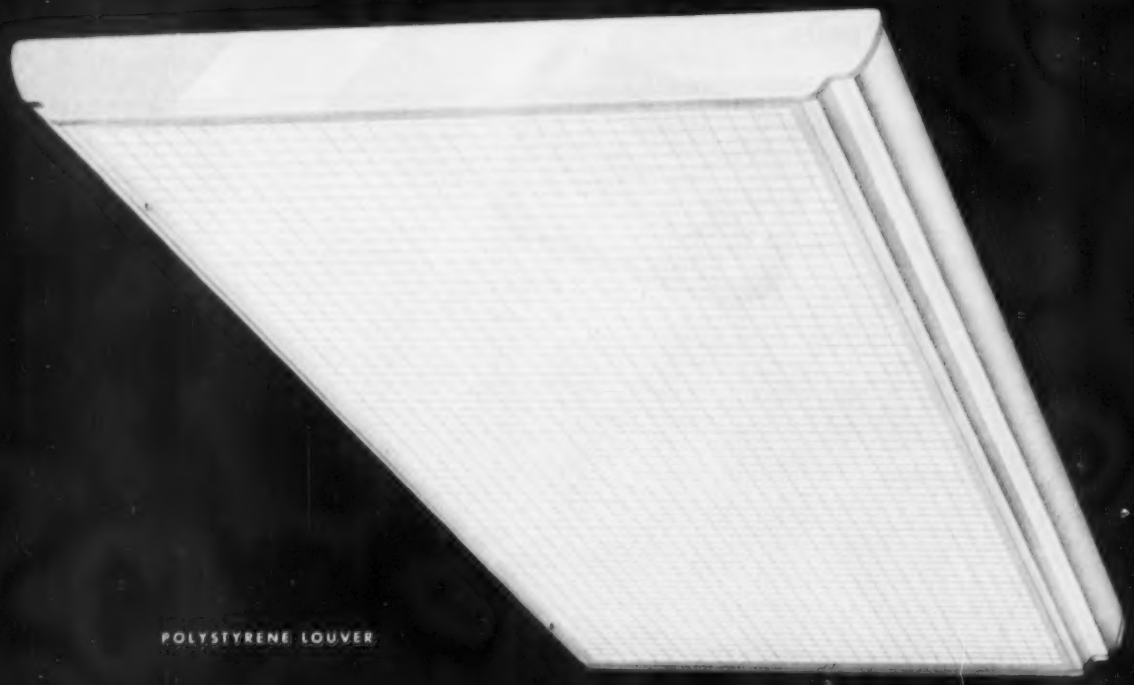
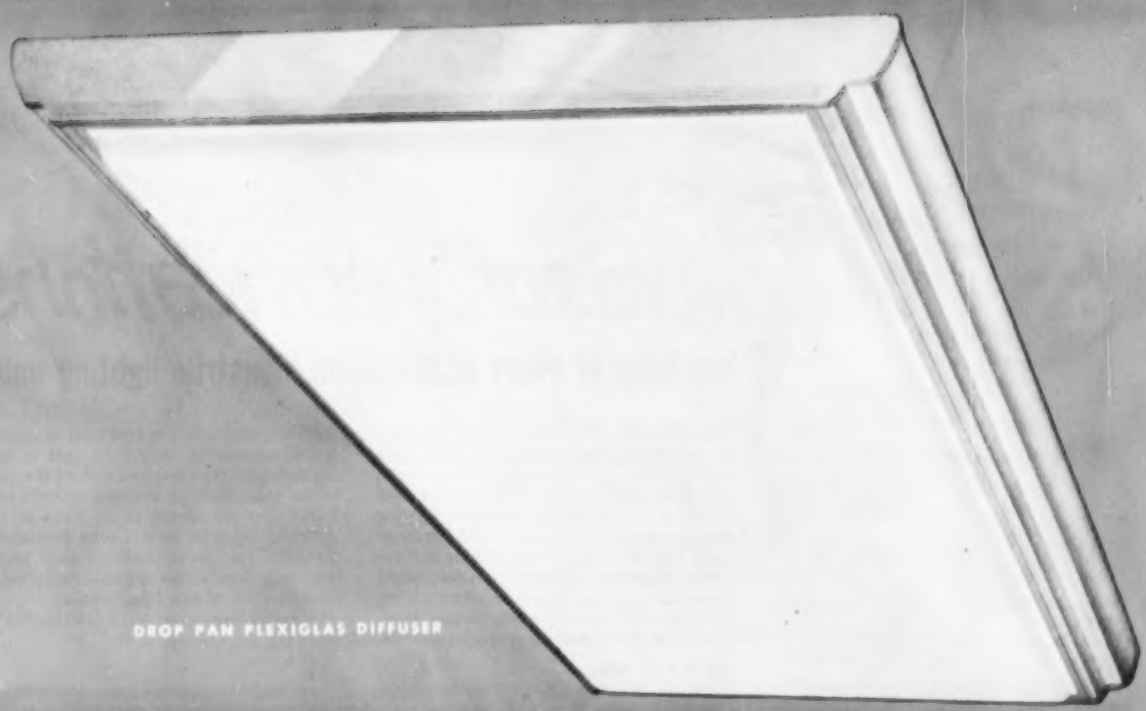
The letters RLM stand for Reflector and Lighting Equipment Manufacturers



POLYSTYRENE LOUVER



DROP PAN PLEXIGLAS DIFFUSER

Gibson LIGHTING

GIBSON MANUFACTURING COMPANY

IN CANADA manufactured under franchise by ELECTROLIER MANUFACTURING CO., LTD., Montreal, one of Canada's oldest and largest manufacturers of lighting fixtures.

Available in two- and four-light models (4-light illustrated).

the new Gibson Ceilo-35*

A fixture of incomparable beauty, designed expressly for low-ceiling application. Measures only 2¾" in depth and features exclusive parabolic reflectors which provide a smooth, shadowless panel of light.

Makers of the world's most versatile fixtures

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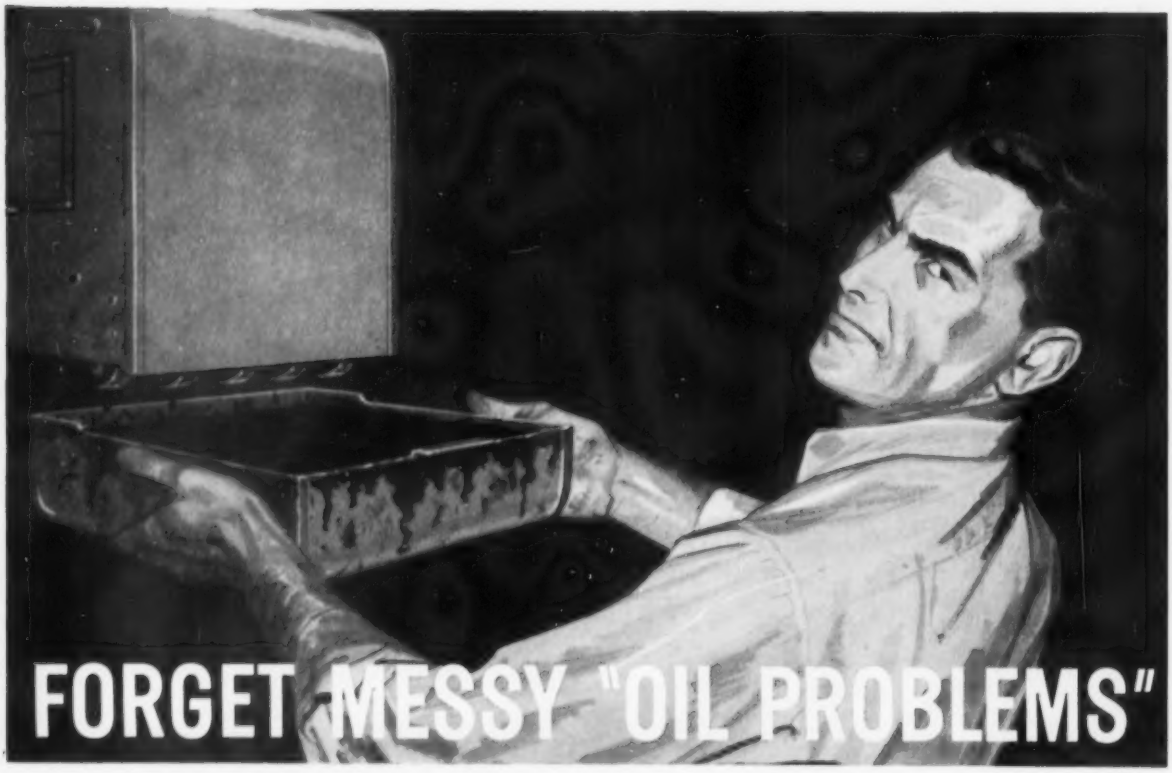
Patent Pending

You really ought to know more about it—so why not drop us a line now for complete information on the Ceilo-35?

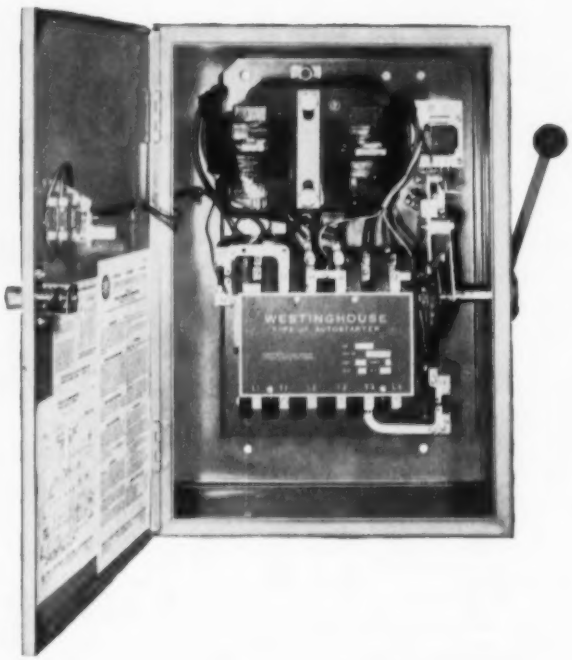
* *Patent Applied For*

1919 Piedmont Circle, N.E., Atlanta 9, Georgia



FORGET MESSY "OIL PROBLEMS"

New Westinghouse "JF" Autostarter offers air break contacts in all ratings

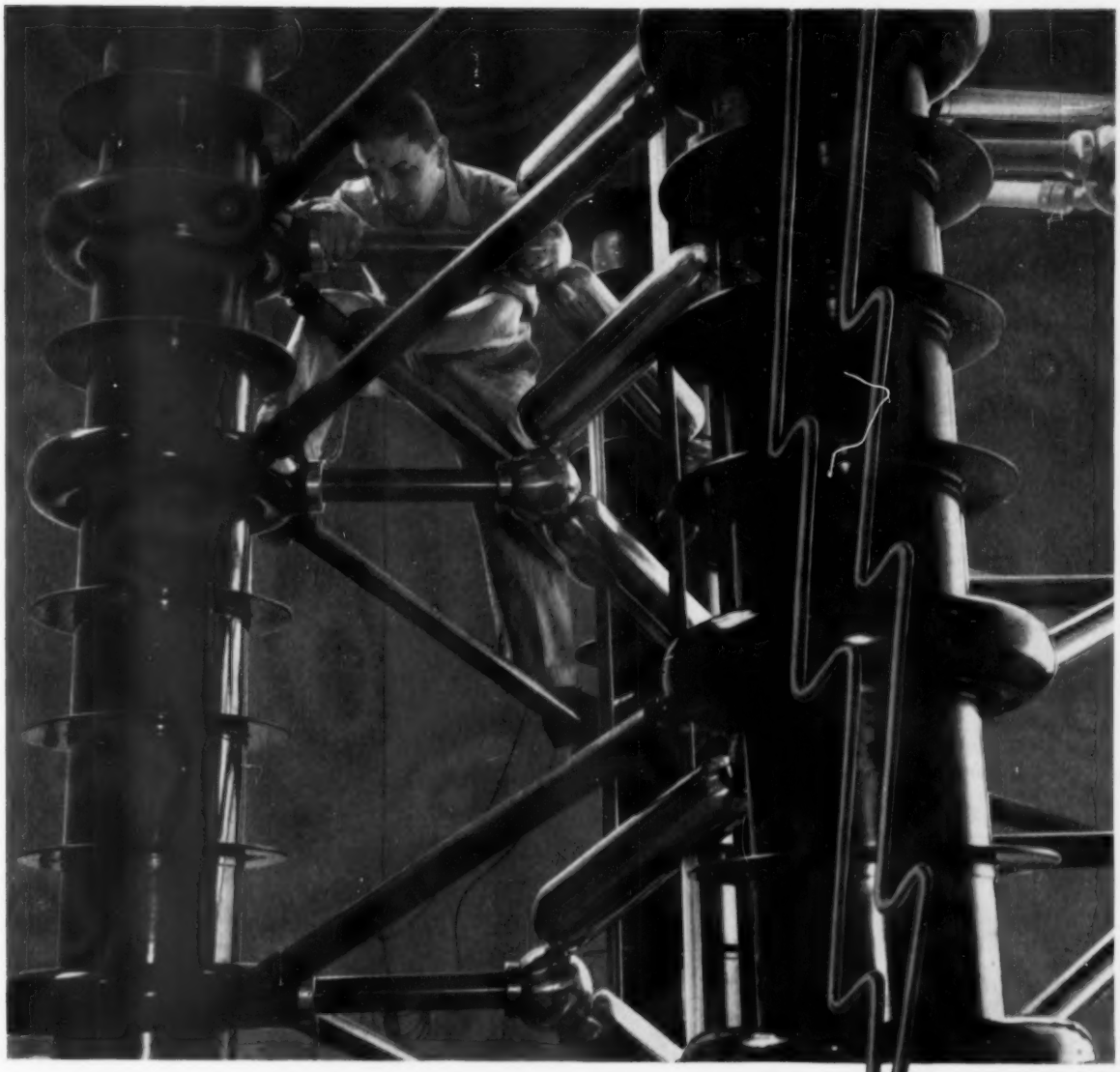


Gone forever are the costly "oil problems" of oil level checks, spilling, oil changes, and hazards from contamination. With air break contacts in all ratings, the new Westinghouse "JF" manual autostarter is the simplest to maintain and most versatile unit on the market.

Tests prove that air break arc interruption provides substantially longer contact life. The Westinghouse "JF" autostarters contain premium quality silver alloy contact surfaces, and in addition, De-ion® arc quenching chambers, which insure long trouble-free service.

POWER-UP with Westinghouse Controls — For all the facts on this new manual autostarter, call your Westinghouse sales engineer or distributor. Or, write Westinghouse Electric Corporation, P.O. Box 868, 3 Gateway Center, Pittsburgh 30, Pennsylvania. J-22066

YOU CAN BE SURE... IF IT'S Westinghouse



Simplex Wire & Cable Company's new 1,400,000 volt impulse generator — the first of its kind to be installed in North America — represents just one aspect of research at Simplex. Simplex scientists and engineers originated the process of vulcanizing portable rubber cords and cables in a lead mold. Simplex developed the first heavy-duty portable electrical cable — Simplex TIREX. The first truly moisture-resistant rubber insulation was the outcome of a commercially acceptable method of deproteinization developed by Simplex. Simplex designed the first interlocked armored cable for underground service — Simplex CONDEX. And now — Simplex C-L-X — the portable, corrugated metallic duct WITH SEALED-IN CABLE. **SIMPLEX WIRE & CABLE CO.**, Cambridge, Massachusetts and Newington, New Hampshire.

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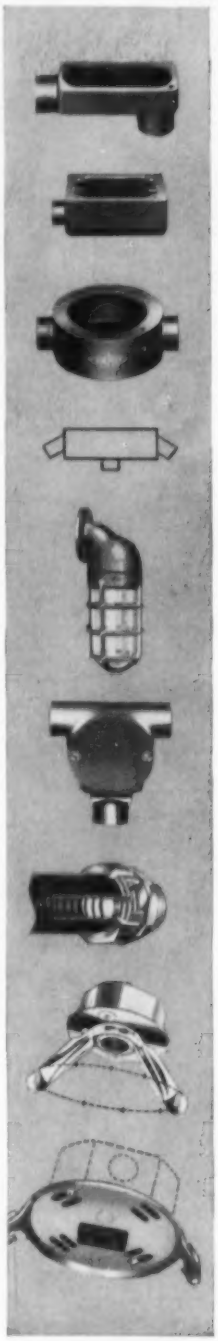
- **SIMPLET WEATHER-PROOF JUNCTION and PULL BOXES** Used in subways, underpasses, bridge abutments. Type A with 4 hubs, type B with 4 hubs at convenient 30° down angle. Extension ring gives greater depth, fits smaller diameter devices.
- **VAPORTIGHT FIXTURES** for universal application. Assorted sizes and styles including popular VW for masonry walls, VU for exposed systems, VO for mounting to sheet metal boxes. Same base with adapter provides quick changeover from 100-watt to 150 or 200-watt units. Long-lasting aluminum parts require no attention for years. Complete accessories including reflectors available.
- **HANGING DEVICES** include the ALC for use with incandescent systems. Accessories, trigger hook lock assemblies, pendant loops, and others.
- **VAP-OIL-TITE CONNECTORS** for use with vapor and oil tight flexible metal conduit. Provides positive seal, prevents costly shorts and down-time!
- **"FRICTION-SET" FIXTURE HANGERS** . . . align lighting systems with a twist of the wrist. Complete assembly.
- **NEW! LOW-COST FIXTURE HANGER** with 38° total adjustment. Provides fast, low-cost mounting right on boxes. Complete with chains, hooks and cord clips.

Ask your wholesaler to show you the new, complete line Catalog X-2000



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You can get these conduit fittings and specialties quicker than any others in the industry . . . Because, Ideal-Simplet always maintains volume stocks at the factory ready for extra-fast delivery service. When you insist on Ideal-Simplet products by name . . . you can be sure you'll get your requirements *when* you need them!

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Here's Why **OPERATING MEN** *specify...*

EC&M
OIL-BREAK STARTERS
(2200-4800 VOLTS)

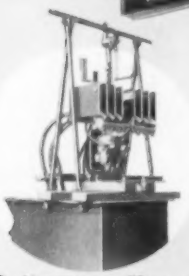
—THEY'RE *Specifically Designed* FOR DUSTY, CORROSIVE ATMOSPHERES

Exterior and interior views of EC&M Type ZHS High Voltage Starter in NEMA 3R (raintight) enclosure with threaded connections for conduit

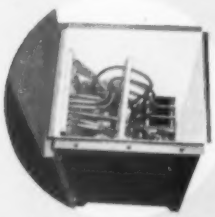
EC&M Type ZHS Starters are a "natural" for adverse atmospheres because the high interrupting capacity ZHS contactor operates under oil. Being totally oil-immersed, this contactor is always well lubricated, protected from corrosion and requires infrequent inspection. There are additional advantages—

QUICKLY INSTALLED because starters are shipped with all internal wiring complete. These ready-to-use starters cut installation time and cost.

HIGH INTERRUPTING CAPACITY • These EC&M Starters are available in enclosures for indoor or outdoor mounting, and are supplied in 3 ratings—*(1)* 50,000 KVA (certified) interrupting capacity (inherent in the starter)—*(2)* with power-type, current-limiting fuses—*(3)* VALIMITOR® (volt-ampere-limitor), the bus may be of unlimited KVA.



With EC&M contactor-lifter, contactor is easily raised above oil level for easy inspection without disconnecting any bolts or leads



Down-view into oil tank. Note compactness of contactor and transformer assembly. All leads are anti-syphon

An installation of six EC&M 2300 Volt Starters and Line Panel for vertical deep-well pumps

EC&M also builds high interrupting capacity AIR-BREAK Starters

THE ELECTRIC CONTROLLER & MFG. CO.
A DIVISION OF THE SQUARE D COMPANY
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Now—conduit that gives sure

DAILY WASHDOWN of 5,000-gallon milk tank is tough test for conduit at Irvindale Farms Dairy, Atlanta, Ga. But no water gets through Sealtite's tough jacket. Wiring is protected. And Sealtite won't rust!

protection to wiring

Sealtite flexible, liquid-tight conduit shrugs off moisture, oil, dirt, chemicals—and outlasts other conduit. Its flexibility cuts installation time, costs—simplifies replacement of parts!

Sealtite* flexible, liquid-tight electrical conduit saves time, trouble and money almost everywhere—indoors, outdoors, in wet spots, dust spots, corrosive spots, where electrical wiring must flex, be moved, absorb vibration, meet misaligned outlets or be installed in cramped spaces.

A tough plastic outer jacket seals out water and corrosive dust . . . protects wiring from weather, oil and chemicals.

And flexible Sealtite is easy to install . . . hugs contours . . . makes a neat appearance . . . saves the time it takes to cut, bend and fit rigid conduit . . . cuts "down time" when electrical gear must be moved or changed.

WHERE TO GET SEALTITE—Electrical Wholesalers stock Types U.A. and E.F.† Sealtite in easy-to-handle coils, in black or gray. Be certain you ask for and get the quality conduit marked "Sealtite." Buy it in long lengths and cut it on the job without waste. Special liquid-tight connectors made by leading connector manufacturers are also available. Free Booklet S-538 gives full information on Sealtite. Write: The American Brass Company, American Metal Hose Division, Waterbury 20, Conn. In Canada: Sealtite is approved by Canadian Standards Association, and sold by Anaconda American Brass Ltd., New Toronto, Ont.

*Trademark †Pat. Applied For 5710S

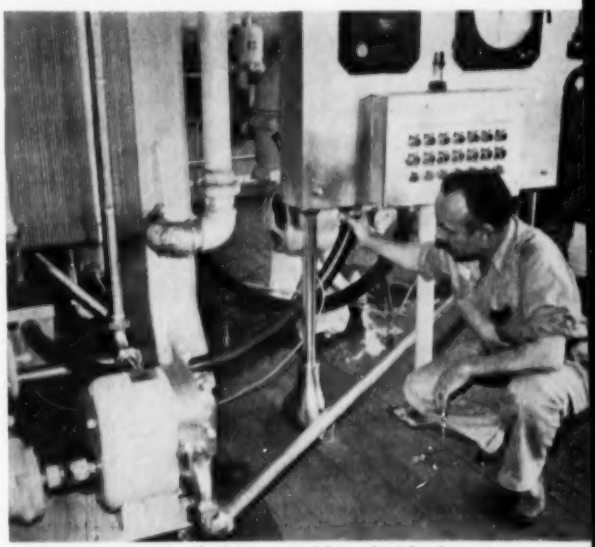
Insist on the conduit marked

SEALTITE

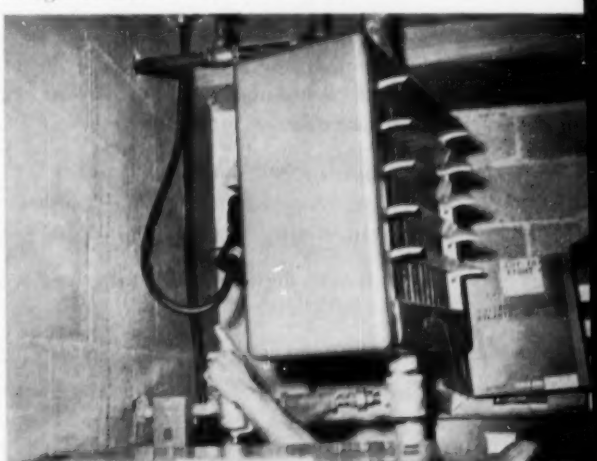
flexible, liquid-tight conduit

an **ANACONDA**® product

OOPS! No crying over spilt milk (or grease or chemicals or what have you) with Sealtite on the job. Where conditions are tough, Sealtite outlasts metal conduit. And it's easier to install.

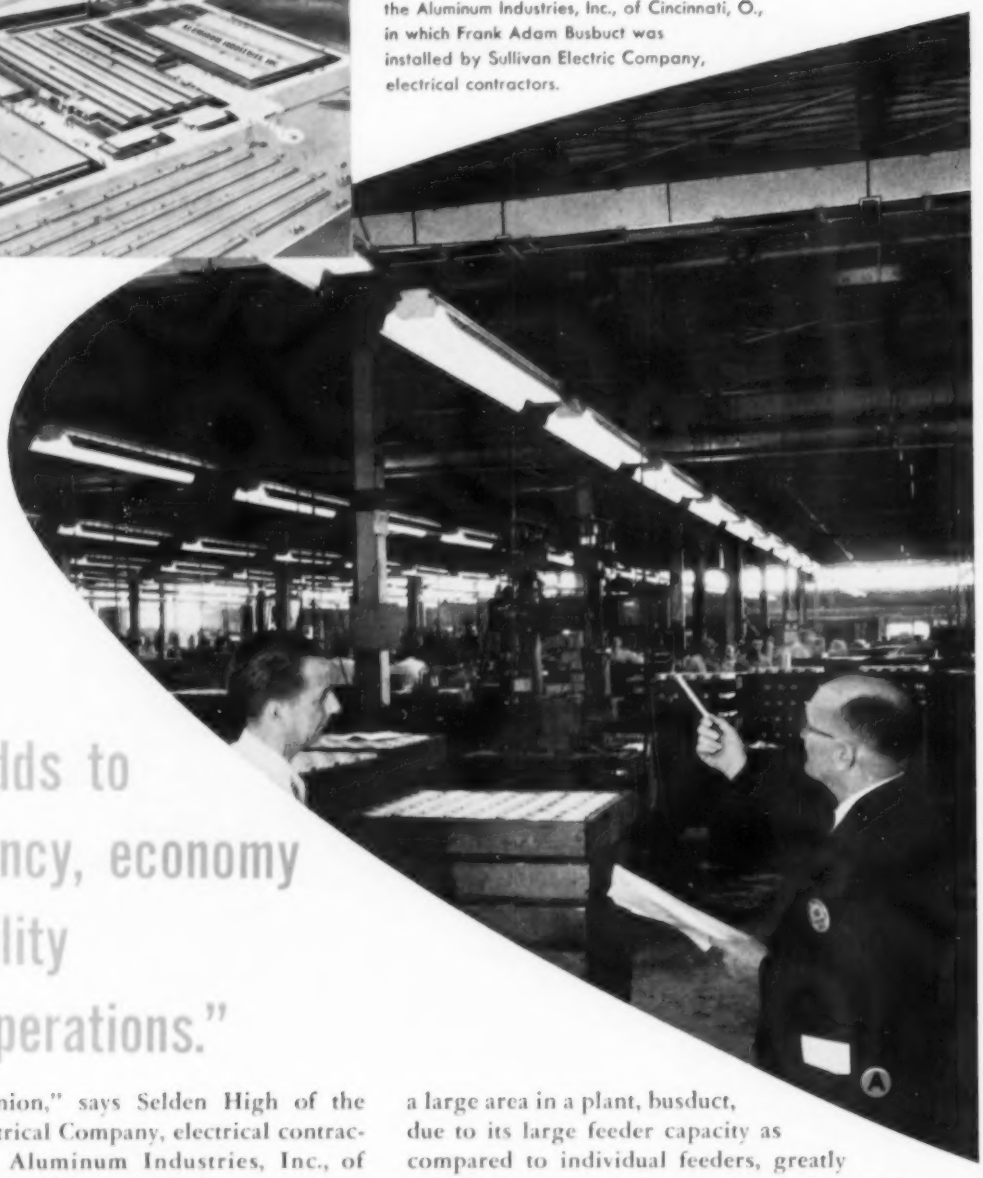


2-INCH SEALTITE extends from panel board of high temperature pasteurizers to floor-type junction box. Sealtite simplifies installation with misaligned outlets . . . there's no rigid conduit to cut, bend and fit.



TIGHT QUARTERS! The job's simple with Sealtite, even in hard-to-reach spots like this. And flexible Sealtite takes up movement and vibration from motor.

General view of the spacious plant of the Aluminum Industries, Inc., of Cincinnati, O., in which Frank Adam Busbuct was installed by Sullivan Electric Company, electrical contractors.



"Frank Adam busduct adds to the efficiency, economy and flexibility of plant operations."

"In my opinion," says Selden High of the Sullivan Electrical Company, electrical contractors for the Aluminum Industries, Inc., of Cincinnati, O., "Frank Adam Busduct is the ideal system of power distribution from service entrance to machines and light.

"Not only is it easy to install, but it has a great many other advantages to recommend it. For instance:

"It is safe, dependable, flexible and economical. Too, it is long-lasting and trouble-free.

"When changes are required in the structural layout of a plant, it may be taken down, moved and salvaged and it retains its original value. And, when heavy loads are to be carried over a large area in a plant, busduct, due to its large feeder capacity as compared to individual feeders, greatly reduces line drop and power losses. It literally makes power available where and when you want it.

"To any firm interested in adding to the efficiency, economy and flexibility of plant operations, I certainly would recommend Frank Adam Busduct."

Mr. High is absolutely right. There is no safer, more dependable or economical system of power distribution than Frank Adam Busduct. Recommend it to all your customers who are interested in greater operating efficiency and lower cost.

A —Selden High of Sullivan Electric Company, electrical contractor of Cincinnati, O., discussing Frank Adam Busduct with Clifford Manderschied.

B —Interior view of the huge Cincinnati plant of the Aluminum Industries, Inc., showing Frank Adam Hi-Efficiency Feeder duct, with a Shutlbrak tap off switch to plug-in duct.

FRANK ADAM

FA

FRANK ADAM ELECTRIC COMPANY

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makers of

busduct • panelboards • switchboards • service equipment

safety switches • load centers • Quikheter

Do you worry about control circuit installation costs WHEN YOU'RE PLAYING GOLF?

You shouldn't! Why not concentrate instead on breaking 90?

Many of your control circuit installation problems, including the cost problem, can be solved if you'll specify and use Rockbestos PNR 600 volt control cable — the cable that's been proven over and over again through more than 14,000,000 feet of installations.

Here's why Rockbestos PNR is your best buy in control cables:

- With it you save on conduit and fittings, cut installation costs.
- Rockbestos PNR lets you pull a 12 conductor control cable in conduit which is now carrying ordinary six or seven conductor cable.
- It's 46% smaller in area — 28% smaller in diameter than conventional control cable.
- It's flexible from 167° to −67°F.
- It's light, easy to handle, pull through conduits.

Get the complete Rockbestos PNR story — write now for detailed specifications and application data.

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ROCKBESTOS

PNR Small Diameter Control Cable

MORE THAN 14,000,000 FEET IN SERVICE

HERE'S A TIME SWITCH THAT'S REALLY

new!

- Ⓣ IT'S "T-RATED"
- Ⓣ IT'S RUGGED . . . HEAVY DUTY
- Ⓣ WITH 4 TIMES THE BREAKING POWER
- Ⓣ CUTS PROFIT KILLING CALL BACKS

At last—from Intermatic, of course—dependable time switches specifically designed to whip the costly troubles of contact welding. Filled with new features, these work horses are TUNGSTEN RATED to carry incandescent lighting loads with an inrush surge of more than *8 times* their normal amperage rating!

WHAT T-RATING MEANS TO YOU . . .

It means a time switch you can install with full confidence of long, continuous, trouble-free performance. It means virtual elimination of expensive call-backs that wipe out profits. And you *still* get all the Intermatic features that make for lightning-fast installation.

NEW ALLOY-T CONTACTS—An amazing new composition that is remarkably *immune* to pitting, arcing and sticking. With increased contact surface and self-cleaning design you get positive contact, better conductivity and freedom from welding.

NEW U-BEAM BLADES—Spring brass and channeled for greater rigidity . . . eliminate blade bounce, give more positive make and break action.

NEW HI-POWER, SWITCHING MECHANISM—gives *four times more* switching power, and positive action, time after time.

WHEN YOU CALL FOR TIME SWITCHES SPECIFY *Intermatic.*

Intermatic
TIME SWITCHES

Approved by Underwriters Laboratories and Canadian Standards Association

INTERNATIONAL REGISTER CO. 2620 W. Washington Blvd., Chicago 12, Illinois

Here's Why...

Silicone Insulated Transformers Provide Reliable Power Anywhere

Locate them anywhere near the load —on the floor, a balcony or wall . . . dry-type transformers insulated with Dow Corning Silicones are lightweight, space-saving and easy to install. They fit into any plant layout. And equally important, they cost less to install, less to maintain, far less in the long run!

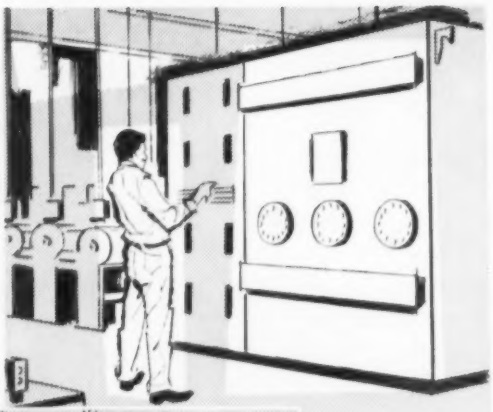
Easy, low-cost installation. Simply connect the necessary leads and throw the switch! Neither sealed nor open type silicone-insulated transformers require costly vaults, barriers or ventilating fans. And they don't contain liquids that can burn, explode or give off toxic fumes. They're completely dry, completely safe.

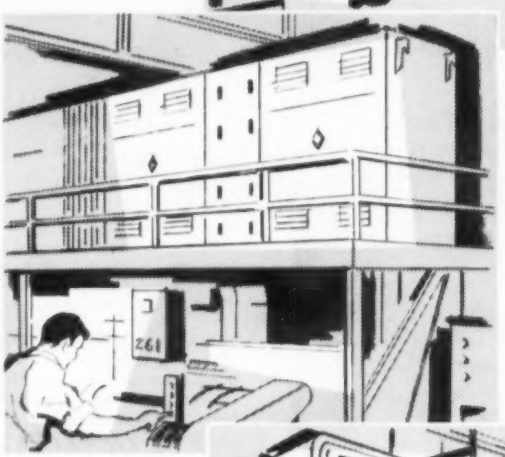
New freedom from maintenance. With no liquids to maintain or toxic fumes to guard against, you install dry-type transformers and virtually forget them. Even in open-type transformers, silicone insulation assures reliable power despite contaminated atmospheres, dust, dirt, moisture or high ambients.

Maximum reliability. Dow Corning silicone insulation has sufficient thermal capacity to handle temporary overloads up to 25% above rated capacity. This extra capacity assures the ultimate in uninterrupted, reliable power for automation . . . continuous processing . . . and all plant functions.

Send today for a list of equipment manufacturers who supply Dow Corning silicone-insulated dry-type transformers.

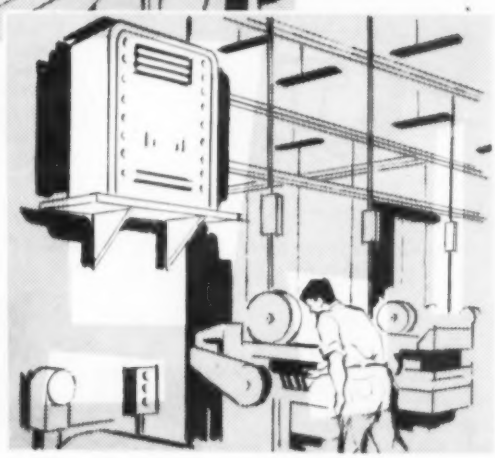
ON THE FLOOR
maximum safety; freedom from maintenance; easy to install





BALCONY
15% lighter than next lightest type; save floor loading

OR WALL
lightweight wall or platform mounted units save floor space



Specify DOW CORNING SILICONES *and Save*

first in silicones

Dow Corning CORPORATION
MIDLAND, MICHIGAN

ATLANTA • BOSTON • CHICAGO • CLEVELAND • DALLAS
DETROIT • LOS ANGELES • NEW YORK • WASHINGTON, D.C.

Now *You* can sell the Beauty of

Custom Lighting

at standard fixture prices

Every store, *every* showroom, *every* restaurant, yes, even offices are top prospects for the Virden Wondabar! This wonderfully versatile kit lets you add the beauty and sales appeal of custom-made fixtures at only a fraction of their cost. And you sell the complete job, not just the installation.

For the Wondabar uses standard Virden fixtures. Lets you select from Virden's wide range of modern, contemporary, period and traditional designs to gain any decorative effect desired. Can be used with dimmer controls for even more dramatic effects. Installation is most economical, too, usually without rewiring or expensive remodeling.

Wondabar kits are available in 3, 4 or 5 arm spreads in almost any length ceiling drop. See your Virden distributor. Look in the yellow pages of your phone book or write John C. Virden Co., 6103 Longfellow Avenue, Dept. ECM, Cleveland 3, Ohio.

Wondabar

by **virden**

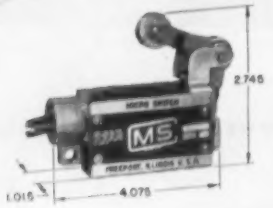
Member American Home Lighting Institute

VIRDEN Lighting

MICRO SWITCH . . . FIRST IN PRECISION SWITCHING

How to
CUT COSTS in
plant production processes
by installing
MICRO SWITCH
Precision Switches

Here are ways plant operators use these versatile switches to give more automatic control

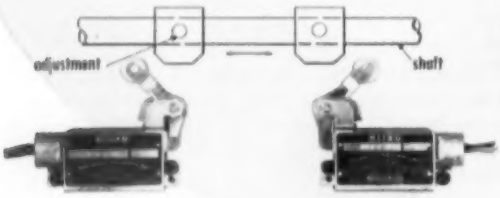


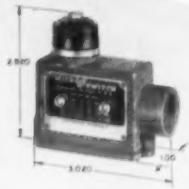
General-purpose limit switch for motion control

Illustrated are two general-purpose limit switches used in a typical motion-control application. Here the stationary limit switches control the motion as they are actuated by dogs on the driven member.

The switches used in this application combine the features of precise operation, rugged construction and excellent sealing in one compact unit. The adjustable roller arm actuator is suitable for fast cam or slide operation. The roller arm is field adjustable through a vertical arc of 260°.

This switch is Underwriters' listed at 15 amps., 125, 250 or 460 vac; ½ amp. 125 vdc; ¼ amp. 250 vdc.



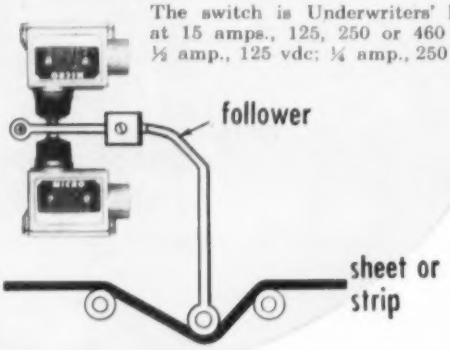


Sealed-plunger switch keeps tension uniform

These precision switches give automatic tension control as material passes to a winding reel. The switches, when actuated by the "follower," speed up or slow down the reel and keep the tension at the proper point.

The switch shown is enclosed and has a sealed-plunger actuator. An elastomer boot on the plunger and a gasket between the bottom plate and the housing seal out lint, dust and other foreign materials.

The switch is Underwriters' listed at 15 amps., 125, 250 or 460 vac; ½ amp., 125 vdc; ¼ amp., 250 vdc.



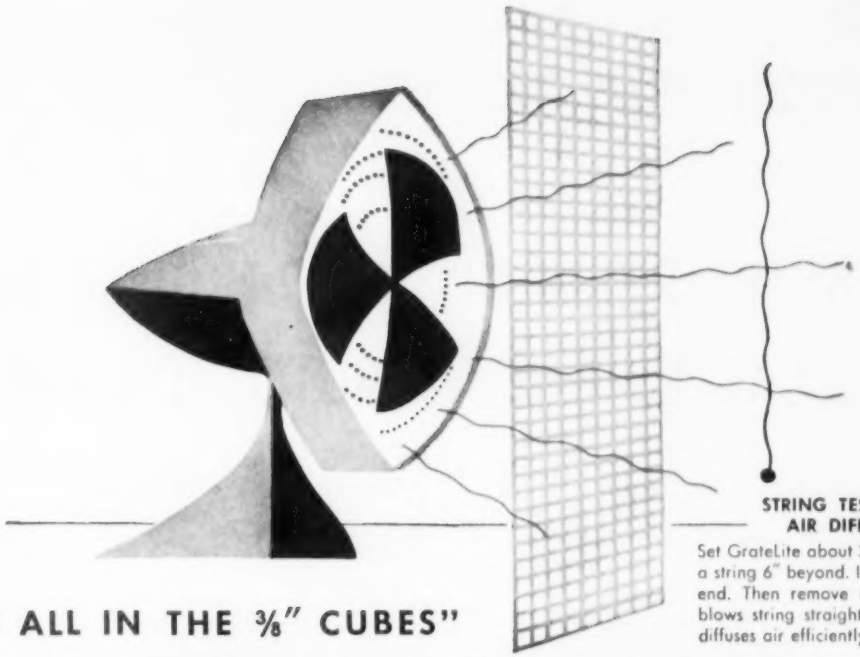
Plant operators have found hundreds of other uses for MICRO SWITCH Precision Switches.

- bin level controls
- safety interlocks
- paint spray controls
- remote valve controls
- automatic die positioning
- thread breakage detectors
- conveyor pile-up controls
- counting controls
- timing circuit controls
- automatic motor shut-off
- automatic length selectors
- remote indicators and alarms
- and many others.

Send for catalog 83 on Industrial Enclosed switches

For complete information contact the Authorized Distributor near you. Technical Field Engineering is available at your MICRO SWITCH branch office.

MICRO SWITCH
A DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR COMPANY
In Canada, Leaside, Toronto 17, Ontario • FREEPORT, ILLINOIS



"IT'S ALL IN THE ⅜" CUBES"

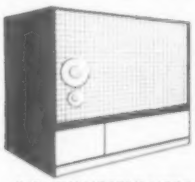
STRING TEST PROVES AIR DIFFUSION!

Set GrateLite about 30" from a fan. Hold a string 6" beyond. It ripples from end to end. Then remove GrateLite—and fan blows string straight outward! GrateLite diffuses air efficiently.

GUTH GRATELITE CEILINGS ARE GREAT!

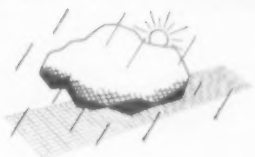
LOUVER DIFFUSER*

SUPER-COMFORT LIGHTING PLUS AMAZING AIR DIFFUSION



AIR CONDITIONERS USE ITS PRINCIPLE!

Small GrateLite-type plastic cubicles are used on latest model air conditioners to diffuse air efficiently. GrateLite scatters—diffuses AIR!



UNAFFECTED BY HUMIDITY!

GrateLite is one solid piece—not just glued-together pieces! It is dimensionally stable, and is unaffected by changes in humidity or by high humidity itself. GrateLite is a solid body!

TOUGH AND RUGGED!

You can step on GrateLite . . . it won't mar, crumble or crunch. Its solid tapered vanes are Guth-engineered for maximum strength and ruggedness—important in maintenance!

STANDS ROUGH HANDLING!

GrateLite won't bend, buckle or mar when taken down for cleaning and relamping, etc. It won't twist in your hand. Its body and substance are designed for long use.

SCRATCH-RESISTANT!

GrateLite doesn't scar easily—or rip or break when dropped or struck by a tool. Fingernails can't mar its usefulness. No "black eyes," no damaged cubicles to destroy overall beauty and efficiency.

KEEPS ITS BEAUTY!

GrateLite holds shape when washed. Won't oxidize or blacken. Cubicles retain their shape. Scratches are unnoticeable. GrateLite isn't flat, dull or depressing. It's always cheerful, life-like and radiant.

WRITE FOR DETAILS TODAY

THE EDWIN F. GUTH CO. **ST. LOUIS 3, MO.**

TRUSTED NAME IN LIGHTING SINCE 1902

* U. S. Pat. No. 2,745,001. Can. Pat. 1957, No. 538,245

IF IT CARRIES CURRENT, K/W CARRIES IT!

NEW LAYTEX-RESIN INSULATION GIVES K/W CONTROL CABLES FINEST PROTECTION MADE!

Greatest Insulation Advance in 25 Years!

Now with new "Kaiser Master" Control Cables, KW brings you *Laytex®-Resin* . . . the greatest advance in insulation since the introduction of pure-rubber Laytex insulation in 1932.

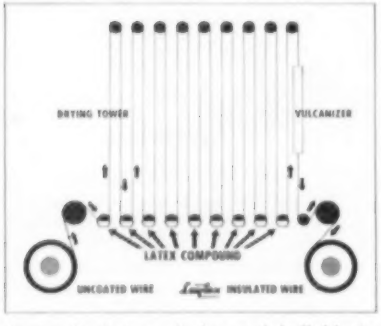
In Laytex-Resin, the synthetic resin conductor covering becomes an integral part of the insulation. The resin is applied in the same dip process as the Laytex, and is fused right into the rubber. This eliminates the need for protective braid covers, which in turn permits greatly reduced cable diameters!

In addition to smaller diameter and resulting lighter weight, Laytex-Resin cables offer all these other advantages over cables with braided conductors:

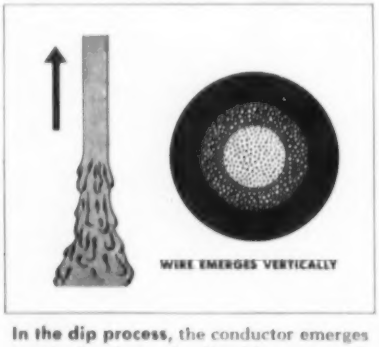
1. **More complete (100 per cent coverage) protection of the insulation.**
2. **Greater protection of the insulation against acids, alkalies, flame, fungus, moisture, oil, ozone and light checking.**
3. **Cover does not fray or wick moisture.**
4. **Splicing and taping made easier.**
5. **Smoother conductor surface.**
6. **More attractive colors (including stripes).**

For a record of dependability in municipalities all over America, KW Laytex-Resin Control Cables are backed up by twenty-five years of perfect service given by their predecessors, Laytex insulated control cables.

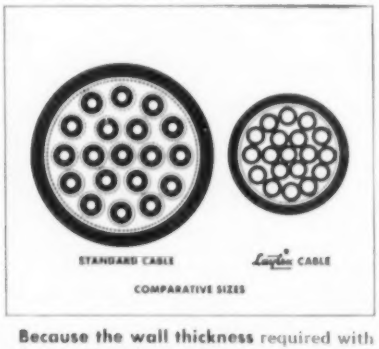
KW "Kaiser Master" Control Cables more than meet the standards set up by I.M.S.A. Specifications No. 16. These cables have tinned or alloy-coated solid copper conductors in accordance with A.S.T.M. requirements. The choice of an overall protective covering for these cables is determined by the customer and is governed by conditions of installation and use.



Laytex-Resin is applied to each individual conductor by the dip process diagrammed above. Because the rubber is applied in unmilled form and the resin is bonded directly to it, Laytex-Resin insulation has no "grain"—its physical properties are *uniform in all directions.*



In the dip process, the conductor emerges vertically from the liquid compound, forming the compound in uniform layers around the conductor. This results in a perfectly centered conductor and permits an insulation with thinner walls than are possible with extruded rubber.



Because the wall thickness required with Laytex-Resin is only one-third to one-half that required for conventional insulations, and because braided conductor covers are eliminated entirely, Laytex-Resin makes possible *more wires per conduit* . . . plus reduced weight and increased flexibility.

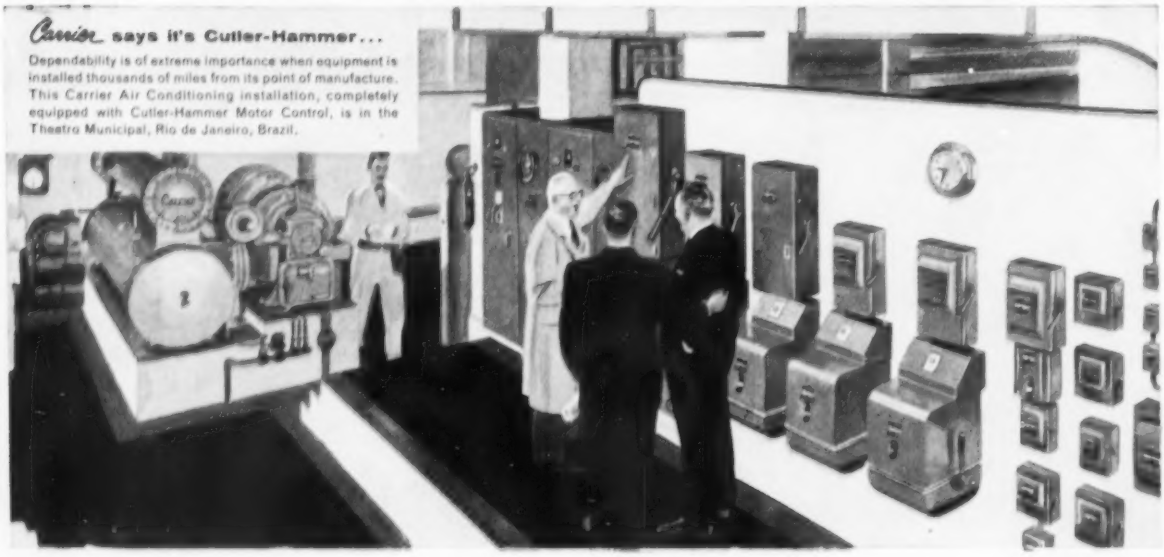
The properties and the performance demonstrated by KW Laytex and Laytex-Resin Control Cables all add up to unequaled *Dependability*. These cables may be installed (1) in conduits, ducts or trays, (2) as aerial cable on a suitable messenger, or (3) buried in the ground.

For immediate service, or for further information and samples, call the Kaiser Aluminum sales office or the KW distributor listed in your telephone directory. Kaiser Aluminum & Chemical Sales, Inc., *Executive Office,* Kaiser Bldg., Oakland 12, Calif.; *General Sales Office,* Palmolive Bldg., Chicago 11, Ill.

Kaiser Aluminum

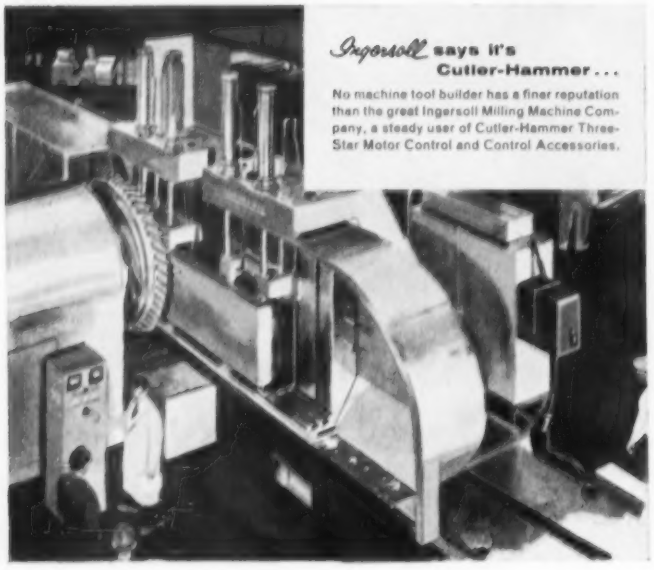
IF IT CARRIES CURRENT, KW CARRIES IT!

The leaders have a name for it



Carrier says it's Cutler-Hammer...

Dependability is of extreme importance when equipment is installed thousands of miles from its point of manufacture. This Carrier Air Conditioning installation, completely equipped with Cutler-Hammer Motor Control, is in the Theatro Municipal, Rio de Janeiro, Brazil.



Ingersoll says it's Cutler-Hammer...

No machine tool builder has a finer reputation than the great Ingersoll Milling Machine Company, a steady user of Cutler-Hammer Three-Star Motor Control and Control Accessories.

Black and Decker says it's Cutler-Hammer...

Black & Decker portable electric tools have won world-wide respect for their high quality, dependable performance, and reliable service. Cutler-Hammer tool handle switches are used extensively.

The proper performance of any type of equipment powered by electric motors depends very directly on the proper performance of the motor control used, whether this control is a small switch in the handle of an electric drill or many panels of control units for industry's newest marvel of automation. No tool, machine, or assembly of complex mechanisms can be any more dependable than its control component.

This importance of dependability in motor control has long been recognized by the leading manufacturers of machines and equipment using it. Their successes and reputations could not have been won without it. There must be much meaning in the fact that so many of these leaders building so many different kinds of motorized products have agreed on *one* name for dependable motor control . . . Cutler-Hammer!

When you seek dependable performance in the machines you build or the machines you buy, specify Cutler-Hammer Motor Control.

* * * CUTLER-HAMMER, Inc., 1306 St. Paul Avenue, Milwaukee 1, Wisconsin. *Associate:* Canadian Cutler-Hammer, Ltd., Toronto.

Cutler-Hammer Three-Star Motor Control, the most advanced general purpose motor control, is stocked for your convenience by a nationwide network of Authorized Cutler-Hammer Distributors.

CUTLER-HAMMER
MOTOR CONTROL
C-H

ELECTRICAL CONSTRUCTION AND MAINTENANCE

57th Year — OCTOBER • 1957

New School Alarms

Two new alarm systems are currently being adapted to use in school buildings. Their successful application should arouse nationwide interest and ought to present a favorable new market opportunity to the electrical construction industry. They should certainly be considered in the preparation of plans and specifications for new school buildings and the modernization of existing structures.

Fire detection systems have come a long way in the past few years. They are simple, reliable and moderate in cost. They can respond sensitively to higher-than-normal temperatures or rate-of-temperature-rise and can also be made to detect, with appropriate auxiliary devices, smoke or visible flame. They are a needed and valuable supplement to the conventional school fire alarm system. In normal, fire-resistant school construction with reasonably good housekeeping, prompt fire detection and location can reduce fire losses materially.

Another system has been developed in response to a growing social problem, particularly acute in big cities, but likely to crop up anywhere. Mischievous and costly vandalism, perpetrated by hoodlums venting their emotional maladjustments in aggression against the community, is rising rapidly. The school is a logical, and conveniently deserted, target during the nighttime hours.

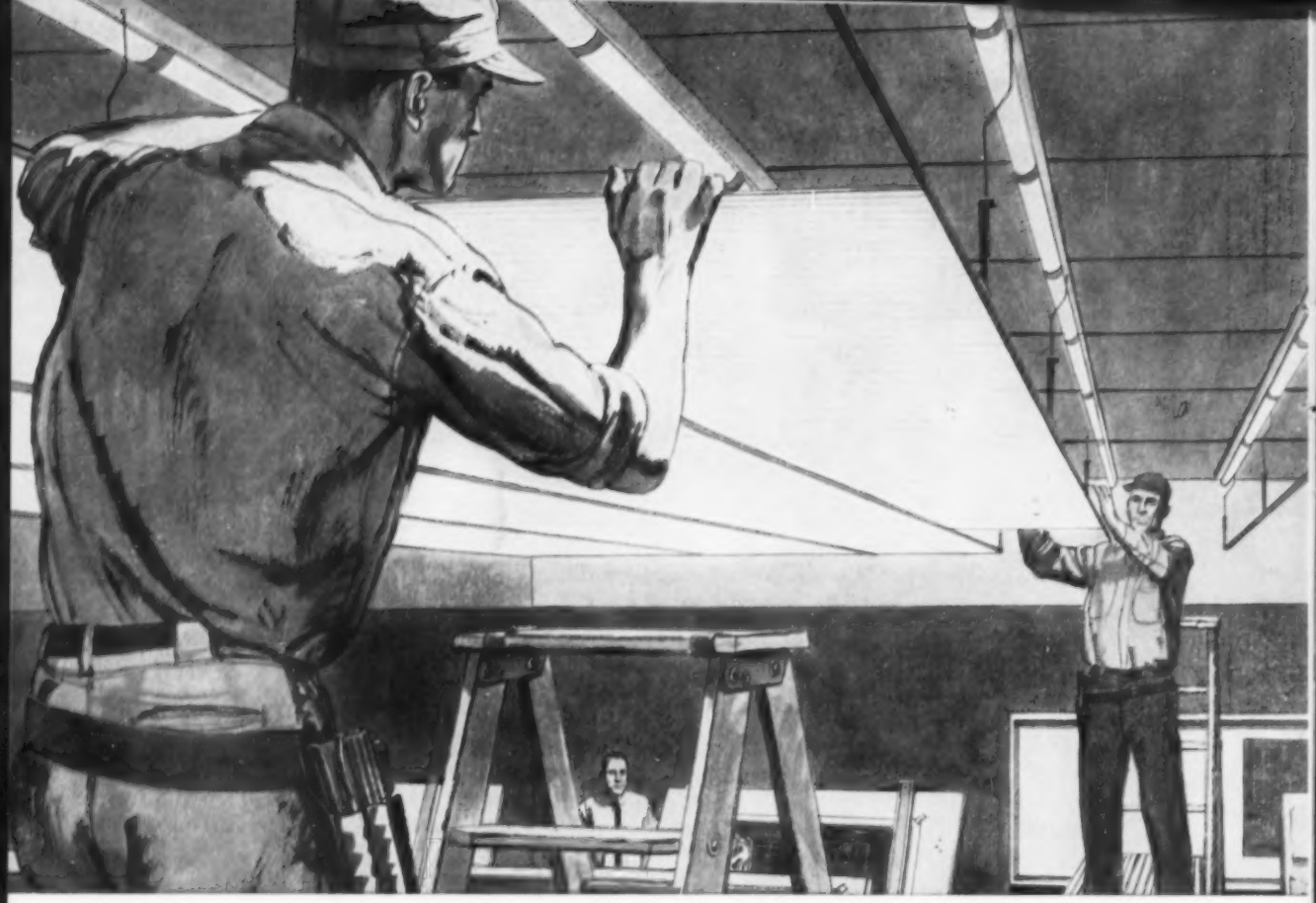
A new vandal alarm, which will soon be installed in a group of seven schools in an eastern city, is expected to pay for itself within one year by discouraging illegal entry and insuring prompt police intervention. It is a sound pick-up system which responds to any unusual noise and provides direct sound surveillance, of the area in which the alarm originates, through a communication circuit to police headquarters.

Knowledge that an alarm system is in operation can be expected to discourage all but the most fool-hardy mischief-makers. And the more daring will be routed or caught before they have time to do much costly damage. Such alarm systems can make our school properties decidedly unattractive objectives for vandalism.

The net repair and restoration costs of preventable fire and vandalism damage are only a part of the resulting taxpayer's burden. In these days of overcrowding and double sessions, temporary loss of the use of a single classroom or school facility can run into great additional expense and serious dislocation of the educational routine for the affected students.

The new electrical alarm systems appear to be prudent investments of the taxpayer's money for the protection and security of our school properties. Their application should be strongly encouraged.

Wm. T. Stuart



Fine craftsmanship and better production stem from easy seeing and uniform illumination. Here is an important project on which Graybar, located in over 130 principal cities, can give you or your customers real help.

Your best source of

EVERYTHING IN LIGHTING

...is Graybar

Whenever you are confronted with the need for better lighting in any plant, office or warehouse area, talk with a Graybar lighting expert. For, whatever the requirements, he can give you an impartial recommendation for the best lighting system for the need–from the most complete selection of lighting units and G-E lamps available from any one source!

The Wakefield "Magic Ceiling," illustrated above, is an example. Units arrive on the job as a complete package: fluorescent strip lighting, straps, channels, grid and diffusers. No preliminary construction is required and the Magic Ceiling can be installed practically overnight.

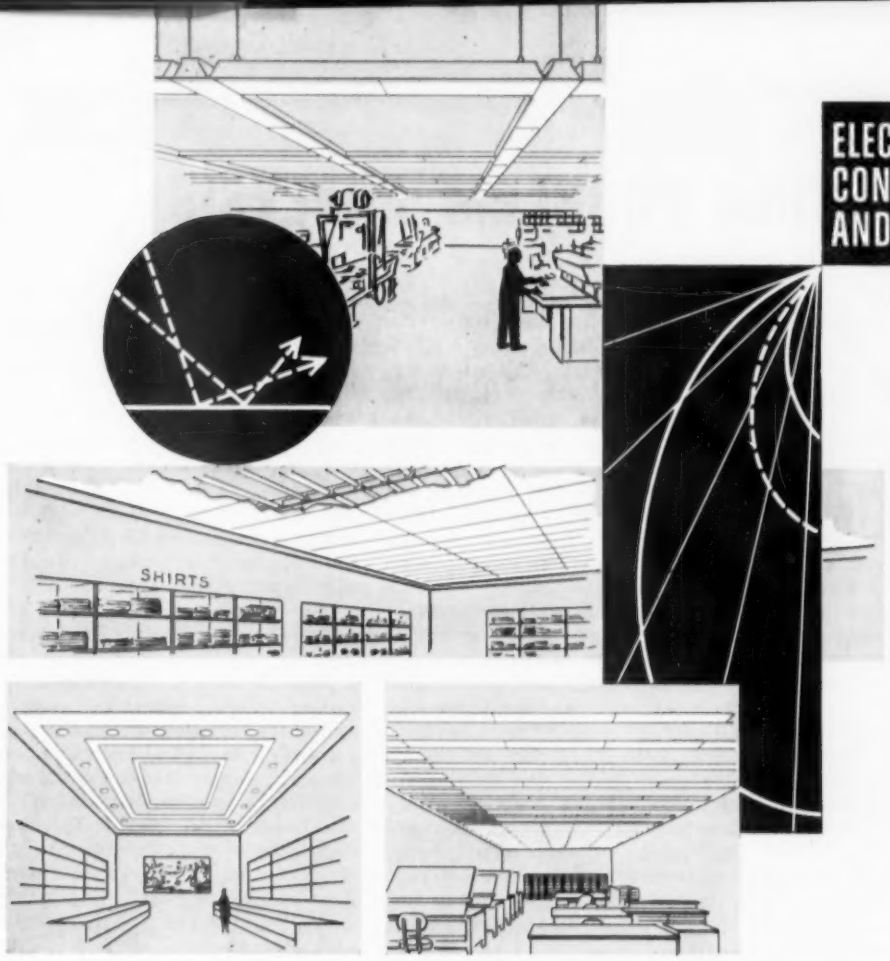
New lighting developments such as this are constantly being announced by the manufacturers of America's best illumination equipment whom Graybar represents. Some of these are: Benjamin, Curtis, Day Brite, Pittsburgh, Silvray, Smithcraft, Wakefield, Wheeler, and Wilson. You and your customers have direct access to this current progress in G-E lamps and lighting equipment when you work with the nearest Graybar office. 696-410

Write Graybar for your copy of "NEW INTERIORS FOR OLD"

which shows striking transformations made within a few hours by installing the "Magic Ceiling." This new lighting source comes in stock units to fit interiors of all sizes and shapes.

CALL GraybaR **FIRST FOR**

GRAYBAR ELECTRIC COMPANY, INC., 420 LEXINGTON AVENUE, NEW YORK 17, NEW YORK, IN OVER 130 PRINCIPAL CITIES



ELECTRICAL CONSTRUCTION AND MAINTENANCE

A Special Report

APPLIED LIGHTING

Layout and Design Data

Roundup of technical data and practical procedures for use in the design of efficient and high quality lighting systems.

LIGHTING system design and layout practices are the foundation and framework for lighting progress. As new developments in products and new ideas in application design are put to use, lighting progress continues to be made.

Lighting progress over the past decade has been at a rapid pace. New ideas and new product developments have ranged over a broad array of light sources, luminaires, lighting equipments and components, and lighting design and application techniques. Lighting results have been greatly improved through the use of more quality design features. And there is now a growing new appreciation for better coordination of light and architecture, and of lighting and decoration.

Keeping pace with progress becomes more difficult as progress picks up speed. In the lighting industry there is a wealth of technical literature and accumulated experience, from which lighting men can draw help and guidance. From this material the most essential and useful data for lighting system design and layout have been assembled and are presented here in condensed form for the convenience of the lighting designer, and to aid in furthering lighting progress.

LIGHTING PROBLEM ANALYSIS

THERE are three factors involved in the process of seeing: 1) the eyes; 2) the visual task; and 3) light. Without eyes, we cannot see. Also, without light, we cannot see. Eyes and light are thus inseparable partners in the function of visual discernment.

Some people have defective vision, which can be corrected with glasses. These are prescribed by eyesight specialists. Almost all eyes decrease in efficiency with age; or, from the viewpoint of the illuminating engineer, more light is required for equal ease in seeing by older persons.

The visual task is usually a fixed condition, and there is little that can be done about it. For example, reading a printed page consists of seeing the detail of letters printed on a specific color and quality of paper—fixed details which cannot be changed. About all that can be done is to improve the brightness ratio between the visual task and its surrounding background, and create the best possible visual environment in the area where the work is to be done.

Light is a highly flexible factor. It is relatively easy to control. Its intensity can be varied. Highlights and shadows can be created, or the light can be diffused uniformly over an area. Glare can be eliminated, or greatly reduced. Color quality of the light can be controlled. Or, light can be used as an architectural feature of a structural design, as ornamentation or decoration, and as a control of brightnesses in the field of vision when combined and coordinated with the colors and reflectances of all surfaces within the area. This, then, is the highly interesting and important field of the lighting design engineer, in creating a custom-tailored visual environment specifically suited to the end use requirements of the area.

In the design of a lighting system for any area, the first step is therefore to determine the end use occupancy of the area, or the type of activity that will be carried out in the area. The type of occupancy will establish the degree of criticalness of the seeing tasks involved, the lighting levels indicated, whether the lighting is to be predominantly utilitarian or decorative, and other similar considerations. Tables and charts on this and the following pages will be helpful in establishing suitable lighting design criteria for an appropriate lighting system.

The second step in selecting an appropriate lighting system for an area is to consider the physical aspects of the area—length, width, ceiling height, structural design and characteristics, materials used for ceiling, walls and floor, and finish and reflection factors of all exposed surfaces. The type, size, color and finish of all interior furnishings—machinery, furniture, fixtures, draperies, etc.—should also be determined and considered. These physical characteristics will affect the efficiency of the lighting system, and will influence the "coefficient of utilization" value to be

LEVELS OF ILLUMINATION

	Footcandles
Starlight	0.0002
Moonlight	0.02
Street Lighting	0.5 – 1.5
Daylight	
At North Window	100 – 200
In Shade (Outdoors)	100 – 1,000
Overcast	300 – 5,000
Direct Sunlight	5,000 – 10,000

ELECTRIC LIGHTING LEVELS

Office Lighting	50 – 100
Store Lighting	
General	25 – 50
Display Areas	100 – 250
School Lighting (Classrooms)	30 – 75
Drafting Rooms	50 – 150
Manufacturing Processes	
Rough	20 – 30
Medium	30 – 75
Fine	50 – 150
Extra Fine	100 – 300

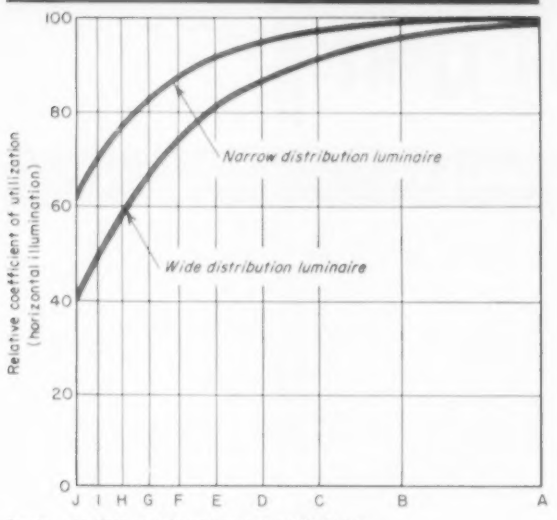
Source: Westinghouse Lighting Handbook and EC&M

BRIGHTNESS OF LIGHT SOURCES

	Footlamberts
Star	4,275,000,000
Sun	450,000,000
Snow (in Sunlight)	9,000
Moon	1,500
North Sky	1,000
Zenith Sky	300
Filament Lamps	
500 watt clear (filament)	3,390,000
500 watt IF	95,000
200 watt IF	65,000
60 watt IF	16,000
Gas Mantle	10,000
Kerosene Lamp	2,500
Candle Flame	1,500
Fluorescent Lamps	
30WT8/CW	2,900
96T12/CW 800 ma	2,650
90WT17/CW	2,250
42T6/CW	2,050
40WT12/CW	1,900
96T12/CW 425 ma	1,850
40WT17/CW	1,100

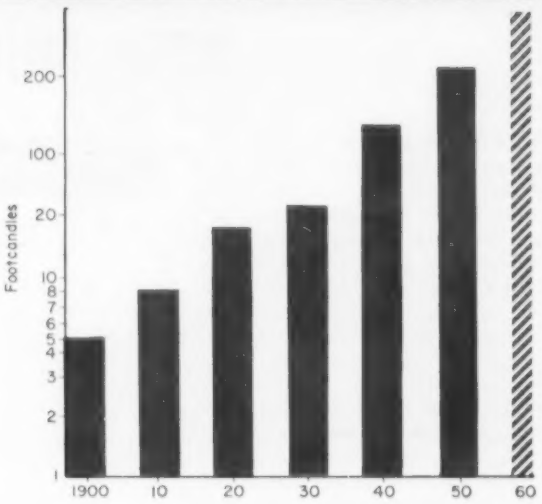
Source: Bulletin LD-2, G. E. Co., Nela Park

LARGE AREAS USE LIGHT EFFICIENTLY



Source: Westinghouse Lighting Handbook – 1956 Edition

RISE OF ACCEPTED GENERAL LEVEL OF ILLUMINATION



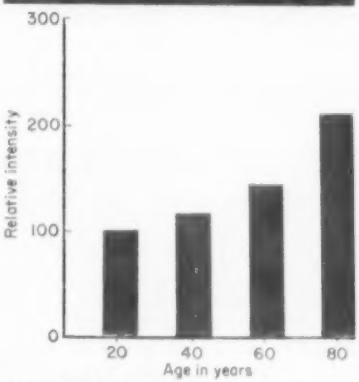
used in calculating the illumination level which may be expected from any given type of lighting system.

Once the end use of the area, and its physical characteristics have been determined, the visual seeing tasks and their degree of severity will be established automatically. The lighting engineer will then be able to select or design a lighting system specifically tailored to provide the best solution possible for the seeing problems involved.

In general, most seeing tasks have been lighted in a variety of ways in the past, and the lighting engineer may draw upon his own experience, or that of others, and select the type of lighting which he considers most appropriate based on these past experiences. Or, he may do some research on the problem, and work out a new solution.

To do this, he will first analyze thoroughly the seeing task. He will determine the *size* of the object or detail to be seen, whether it is opaque, translucent, transparent, polished, matte, or some variation of these; he will determine the *contrast* of the object to be seen with its immediate background; study the *brightness* of the detail under varying illumination intensities; consider the *time* which may be available or required to see the object or detail, and the *brightness ratio* of the detail and its surroundings. Then, after considering each of these factors in seeing in relation to other existing physical characteristics, he may devise and develop new lighting techniques custom-designed to solve the existing seeing tasks which comprise the lighting problems of this specific project. This latter approach is, of course, preferred, and should be used in any case where the benefits to be derived from such personalized study and research will justify the time and effort.

OLDER EYES NEED MORE LIGHT



Source: IES Lighting Handbook

FACTORS IN SEEING

1. **Size** of object or detail.
2. **Contrast** of the detail with its immediate background.
3. **Brightness** of the detail.
4. **Time** available to see it.
5. **Brightness** *ratio* of object or detail and its surroundings.

The importance of properly analyzing the lighting problem, before attempting to select the lighting system, cannot be ignored. Only through this analysis can it be determined what the final lighting result should be. The analysis will help to establish the desired lighting intensity, brightnesses, brightness ratios and contrasts, directional quality of the light, color quality of the light produced, lighting quality as appraised by seeing comfort, harmony in color treatment for decorative purposes, architectural and decorative appropriateness, and other qualities.

Any specific lighting problem may, of course, be solved by any of a wide variety of solutions. The lighting engineer's job is to carefully appraise all pertinent factors relating to the job, and to select the solution most appropriate under the given set of conditions.

For example, the type of light source to use for maximum visual acuity, and for the most appropriate color quality, is important. Also, the quality of the lighting, or its absence of glare, and degree of uniformity, for certain types of visual tasks, or the control of highlights and shadows, for other types of visual tasks, are all factors to be considered. For most lighting problems, general illumination will usually be preferred.

HOW MUCH LIGHT

SINCE the early days of electric lighting, the measure of a lighting installation has been the illumination intensity provided. This intensity is measured in footcandles. The amount of light provided for an installation, up to the time of the development of mercury vapor and fluorescent lamps, was usually limited by the inefficiencies of the lamps (light output ranged from 15 to 20 lumens per watt), and by economic considerations.

Since the development and use of mercury vapor and fluorescent lamps, with their higher efficiencies, illumination levels have been greatly increased. These higher lighting levels have been possible economically, but as they have spiraled upwards, they have introduced other limiting factors. Thus the appraisal of a lighting installation today involves other considerations than lighting intensity, such as quality of the light, diffusion, elimination of glare, highlights and shadows for modeling effect, brightness ratios, colors, and other such factors.

How much light is needed for a specific lighting installation? How many footcandles are desirable, and how much light can be provided economically? In general, arbitrary standards have been set up as representative of good lighting practice, and these standards have been periodically revised upward. These arbitrary footcandle standards have usually been based on intensities in general use, and found from experience to be economically practical. As light source efficiencies have increased, it has been possible to step up the illumination intensities at no increase in operating cost. Current recommended levels of illumination, based on the severity of the visual tasks, are given in the chart at right.

Many lighting engineers like to consider the illumination levels, reflection factors, and brightnesses found outdoors on a clear day in the summer as the ideal, or optimum lighting result, and the condition under which the eye has developed through the ages. It is recognized, however, that not enough is yet known about the control of light and surrounding environments indoors to produce lighting levels much beyond 300 to 400 footcandles that are visually and physically comfortable. Therefore, today's standards for lighting levels are no doubt a compromise with the desirable optimum.

Intensities up to 150 and 200 footcandles are coming into use today for general lighting purposes, especially in manufacturing processes involving inspection or extra fine assembly work, and for drafting rooms and similar areas where seeing tasks involve fine detail over long periods of time.

Supplementary lighting is normally used to provide lighting levels in excess of 150 or 200 footcandles. Such intensities are desirable in display lighting in stores and show windows, for sewing on dark materials, for inspection, and for color work and color identification.

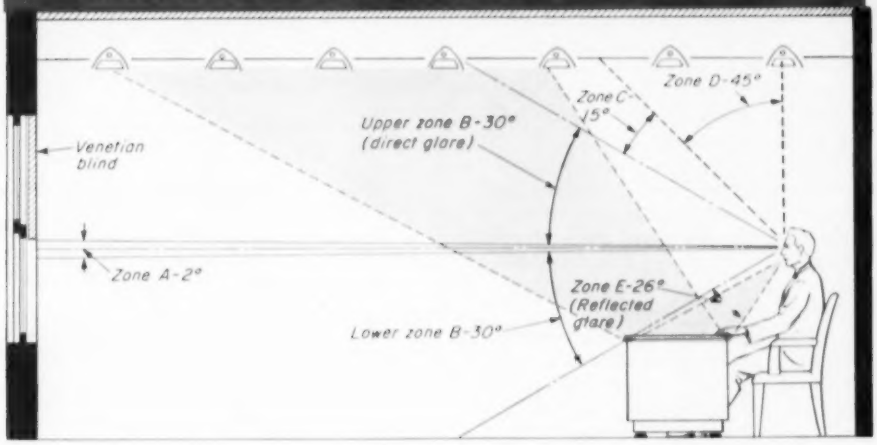
RECOMMENDED LEVELS OF ILLUMINATION

SPECIALIZED TASKS - 1000 footcandles and above. Major surgery. Combating show window reflection in daytime. Spotlighted feature displays.
MOST SEVERE - 500 to 1000 footcandles. Highlighting. Color identification. Watch making. Special inspection.
VERY SEVERE - 250 to 500 footcandles. Color work. Display lighting. Extra fine assembly, testing and inspection.
SEVERE AND PROLONGED - 125 to 250 footcandles. Fine assembly, testing and inspection. Fine drafting. Show windows. Feature displays.
MEDIUM SEVERE - 60 to 125 footcandles. Proofreading. Counter displays. Drafting. Automatic machinery. General assembly, testing and inspection.
MODERATELY SEVERE - 30 to 60 footcandles. General fabrication. Rough assembly, testing and inspection. Classrooms. Library reading rooms. Stores.
CASUAL SEEING - 15 to 30 footcandles. Auditoriums. Cafeterias. Conference rooms. General processing. Casual desk work.
SERVICE AREAS - 7 to 15 footcandles. Rough work. Washrooms. Stock rooms. Shipping and receiving. Dining areas.
OUTDOOR AREAS - 7 footcandles or less. Parking lots. Construction. Protective. Also hallways and corridors; TV viewing; night clubs.
SEVERITY OF VISUAL TASKS *
INTENSITY IN FOOTCANDLES
1280
1000
800
640
500
400
320
300
200
160
100
80
60
40
30
20
15
10
5
Logarithmic scale

* *Arbitrary classification but based on assumption that any visual task that is twice as difficult as another requires twice as much light for equal seeing ease.*

Source Bulletin LD-109, G.E. Co., Nela Park and ECRM.

PREVENTION OF GLARE IMPROVES LIGHTING QUALITY



APPLIED LIGHTING

LIGHTING QUALITY

IN RECENT years, principally since the development and introduction of fluorescent light sources and the installation and use of higher levels of illumination, much more attention is being given to lighting quality in lighting systems. Studies of visual comfort and ease of seeing have indicated that quality of light, including spectral color, absence of direct and reflected glare, light distribution, diffusion, and control, brightnesses and brightness ratios in the field of vision, and other similar quality features, are now considered of equal if not greater importance than quantity of light, as measured in footcandles. Thus one of the major factors included in the appraisal of a lighting system today is a measure of the system's quality, as well as of the number of footcandles provided on the working plane.

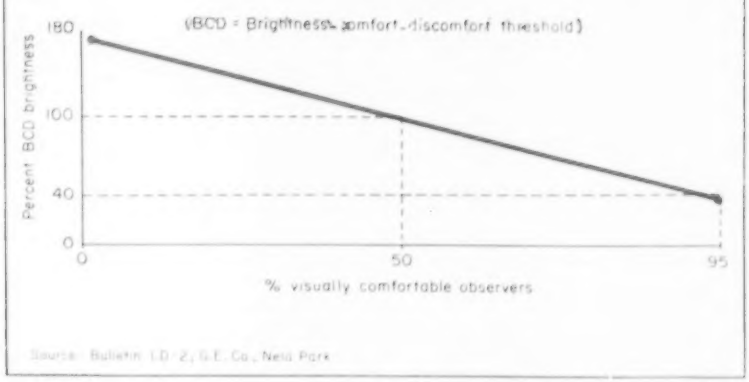
Lighting intensity has long been the yardstick for appraisal of lighting systems. A primary reason, no doubt, is the fact that it has been possible to measure accurately the amount of light falling on a surface, or on the work plane, with an instrument. This instrument is, of course, the illuminometer, or light meter, as it is commonly called. It measures footcandles direct, and eliminates all guess work, including the human element.

Lighting quality is not so easily determined. No meter has been developed as yet which will measure lighting quality, either directly or indirectly. But the need for inclusion of quality in lighting system appraisal has been recognized, and various efforts have been made to develop a means or method for measuring this important factor.

Generally speaking, lighting quality is considered as that inherent attribute in a lighting result known as visual comfort. An interior which is visually comfortable is considered to have a good visual environment. The degree or extent to which visual comfort exists, it has been found, is also the degree or extent to which glare has been reduced, or eliminated. It is therefore logical that methods which have been developed for measuring lighting quality should be methods which measure glare, or the lack of glare.

The concept of a rating method by which the visual comfort of an environment could be appraised, and a system for calculating the "Glare Factor" of a lighting in-

SEEING COMFORT INCREASES AS GLARE DECREASES



Source: Bulletin LD-2, G.E. Co., Nela Park

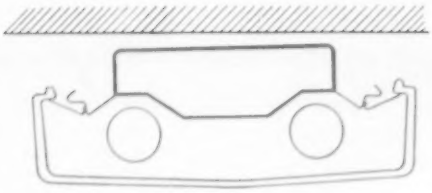
stallation, were introduced in 1945 by Dr. Ward Harrison ("Glare Ratings", *Illuminating Engineering*, Sept. 1945). Through the use of this system and its empirical formula, it is possible to calculate numerical glare factors. Such calculations evaluate the discomfort of an environment.

Glare factors are abstract numbers. They have no units related to sensation, and require interpretation as to the degree of discomfort involved. The glare rating method of appraisal has not been widely adopted.

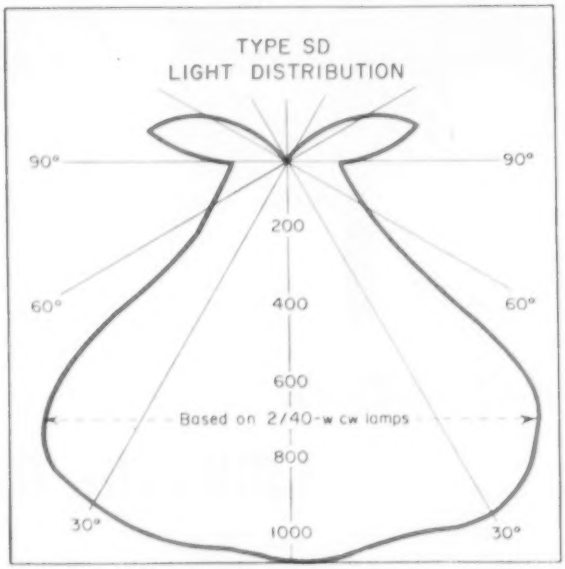
Subsequent research has established a practical relationship between glare factor and the percentage of occupants of a room who will be visually comfortable. This relationship has been incorporated in a simple appraisal system, in which the probable percentage of average observers who would be visually comfortable if placed in the least favorable position in the room, is listed. These percentages become a Visual Comfort Index, and the system is known as the VCI rating system.

A small number of the lighting equipment manufacturers are now supplying VCI values and average brightness data for some of their luminaires, along with the standard coefficient of utilization data and distribution curves. Such data are shown in the illustrations and tables at right for a typical type SD luminaire. A larger number of manufacturers are now supplying average brightness data, some using "footlamberts" as the measure of brightness, others using "candles per square inch". In the interests of clarification and standardization, it is hoped that manufacturers will develop VCI values for their equipment, and publish it along with CU data and average brightness data. Individual lighting designers should learn to interpret "glare factor" values as well as VCI values, and to relate one to the other, and to appraise brightness in either "footlamberts" or "candles per square inch", so that they can reduce the data supplied, regardless of the units used, to a common denominator.

Visual Comfort Index values for five typical luminaires, one each for the five basic types, are shown in the chart on next page. These values may be used for a rough check of visual comfort for any type of luminaire, when specific



Type SD Luminaire



AVERAGE BRIGHTNESS DATA
(in Footlamberts)
Two 2500 Lumen Lamps

Vertical Angle	Across Axis	45° Plane	Along Axis
0°	930	930	930
30°	980	920	910
45°	980	850	775
55°	460	455	470
60°	370	325	385
65°	325	255	320
70°	310	260	270
75°	320	275	260
80°	350	270	275
85°	405	270	280
90°	490	300	0

VISUAL COMFORT TABLE
Luminaire with 2-F40T12/RS cool white lamps.

ROOM WIDTH (in feet)	ROOM LENGTH (in feet)	CROSSWISE CEILING HEIGHT 8½′	10′	13′	ENDWISE CEILING HEIGHT 8½′	10′	13′
15	20	100	100	99	100	100	98
	30	98	98	97	99	99	97
	40	97	97	96	98	98	96
	60	96	96	98	98	98	96
20	20	100	99	98	100	100	97
	30	98	97	97	99	99	96
	40	96	95	96	98	98	95
	60	94	94	95	97	97	95
	80	92	93	94	97	97	95
30	40	94	95	96	98	98	96
	60	91	92	94	97	97	95
	80	89	90	92	96	96	94

Room Reflectances: Ceiling—80%; Walls—50%; Floor—30%.
Source: Holophane Co., Inc.

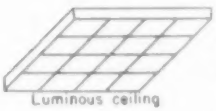
calculated data for the specific luminaire under consideration are not available. In general, however, the lighting designer should have on file and use complete technical data on each of the various types of luminaires he considers for specification and use. Such technical data should include: candlepower distribution curve, zonal lumens, coefficients of utilization, average brightness at various angles, Visual Comfort Index values for a specified lighting intensity and complete lamp, dimensional and installation data.

The VCI rating system is a step forward in the effort to appraise lighting quality, but it is not all-embracing. It takes into account direct glare only and does not include reflected glare. So the lighting engineer must of necessity still take into account several additional factors when making a lighting comfort appraisal. The VCI system will measure the direct glare discomfort of the luminaires only. An analysis of luminaire brightness in the 0° to 30° zone (from vertical) will indicate the brightness in the direction of horizontal surfaces at the working plane, or below—possible sources for reflected glare. Further analysis of surfaces in this potential reflected glare source area, to determine the type of surfaces involved—whether specular, gloss, matte, or some gradation between—and their approximate reflection factors, will enable the designer to approximate the final effect of the luminaire brightnesses reflected from these surfaces. While no meters are available to measure reflected glare, the designer will soon learn to appraise the comfort of a lighting system from the reflected glare standpoint, based on experience and common sense analysis of the known factors. In general, reflected glare is more of a problem in lighting systems of low intensity, 50 footcandles or less, than in lighting systems of higher intensity, 50 footcandles and above. This is true since when the illumination intensity on the work plane or other surface in the reflected glare zone area is 50 footcandles or above, its brightness approaches that of the glare source, the brightness from the luminaire in the 0° to 30° zone.

Other factors which affect lighting quality include the color quality of the light produced by the light sources, the color and brightness of surfaces in the normal field of view, the brightness ratios which result from the various colors and reflectance values, and other possible glare sources. Windows should contain shielding to prevent sky glare or glare from outside sources.

VISUAL COMFORT INDEX VALUES

(For typical luminaires based on 50 footcandles)

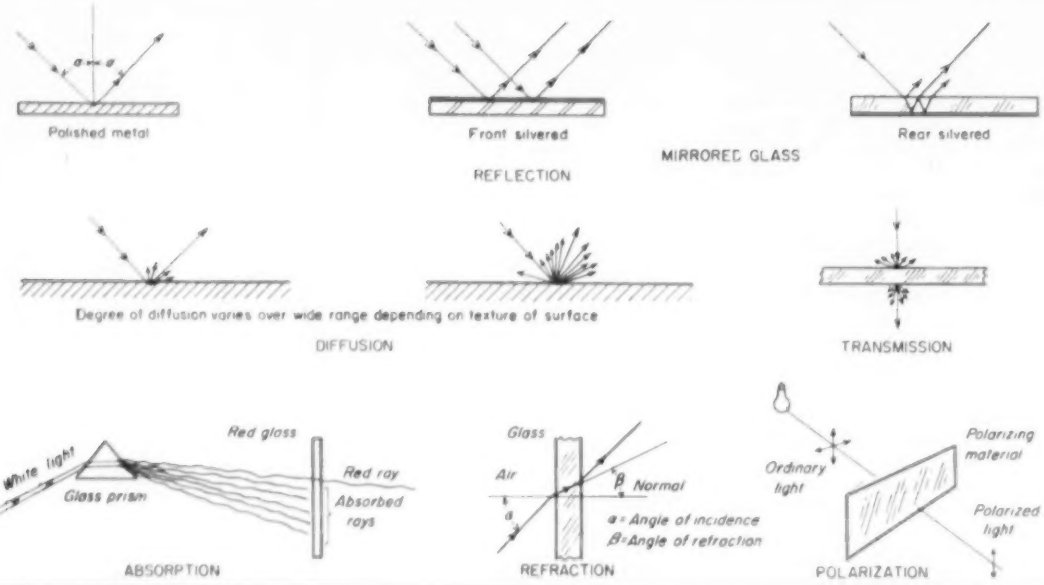
TYPE LUMINAIRE	ROOM WIDTH	ROOM LENGTH	CEILING HEIGHT (FEET) 8½	10	13
Direct	15	20	97+	97+	97+
		40	97+	97+	97+
	20	20	97	97+	97+
		40	97	97+	97+
		60	97	97+	97+
Semi-direct	15	20	86	90	92
		40	86	87	91
	20	20	86	87	91
		40	84	86	89
		60	84	85	88
	15	20	93	95	97
		40	92	93	96
General diffuse	20	20	92	94	97
		40	91	92	94
		60	91	92	94
 Luminous ceiling	15	20	94	95	96
		40	94	94	94
	20	20	94	95	96
		40	94	94	94
		60	94	94	94
Indirect	15	20	92	93	95
		40	91	92	92
	20	20	92	93	95
		40	91	92	92
		60	90	91	92

BRIGHTNESS RATIOS FOR INTERIOR LIGHTING

CONDITION	RATIO
Between visual tasks and adjacent surroundings *Example*: White paper and desk top	1 to 1/3
Between visual tasks and more remote darker surfaces *Example*: White paper on desk and floor	1 to 1/10
Between visual tasks and more remote brighter surfaces *Example*: White paper on desk and luminaire	1 to 10
Between luminaires and adjacent surfaces in normal field of view	20 to 1
Anywhere within normal field of view *Example*: Luminaires and floor	40 to 1

Brightness ratios in the field of view can be reduced by the use of surfaces having approximately the same reflection value. Use of light finish surfaces for desk tops, for example, reduces the ratio of the brightness between white paper (letters) and the desk top surface.

BASIC METHODS OF LIGHT CONTROL



APPLIED LIGHTING

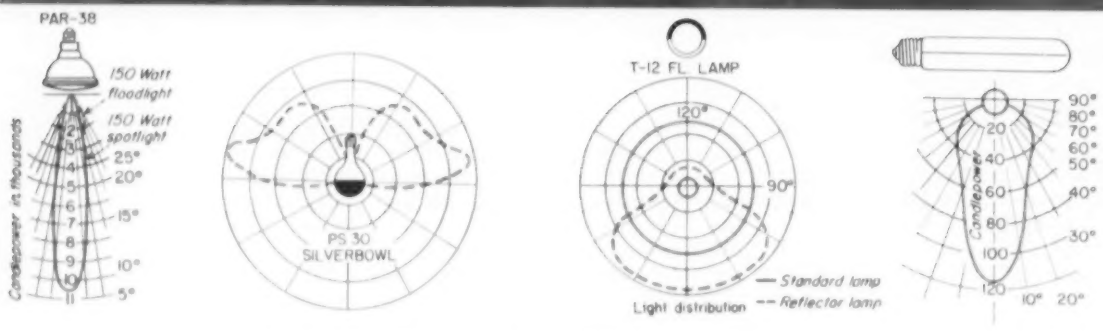
LIGHT CONTROL

THE control of light follows basic laws of physics, laws and principles which are generally well known by most people. The usual means of controlling light are by these physical phenomena: reflection, transmission, refraction, diffusion, absorption, and polarization.

In practice, the field of light control is principally that of the designer of lighting equipment. It is his responsibility to choose the type of light control needed for the type of luminaire being designed, and for light distribution characteristics which he wants the luminaire to have. He has at his command a wide variety of materials with which to accomplish his objectives. He can select reflectors from a broad range of reflecting materials. Reflection characteristics of these materials can be classified under four general types: specular, spread, diffuse, and diffuse specular. Further reflection control can be added by change of reflector contour, and by change of reflector surface finish. Some of the more popular contours are circular, parabolic, circular-parabolic, plane, and elliptical. Typical reflector surface finishes include: mirrored, pebbled, corrugated, brushed, and etched, or diffuse. Diffuse reflection is of three types: diffusely reflecting surfaces (white plaster), spread reflecting surfaces (aluminum painted surface), and diffuse-specular surfaces (porcelain enamel).

The lighting equipment designer also has available for his use mate-

INTEGRAL REFLECTOR LAMPS



rials which transmit light but change its characteristics in the process, light absorption materials, prismatic refractors and reflectors (glass and plastic), and polarizing devices.

Important considerations in the selection of control devices include efficiency, durability, ease of maintenance and attractive appearance.

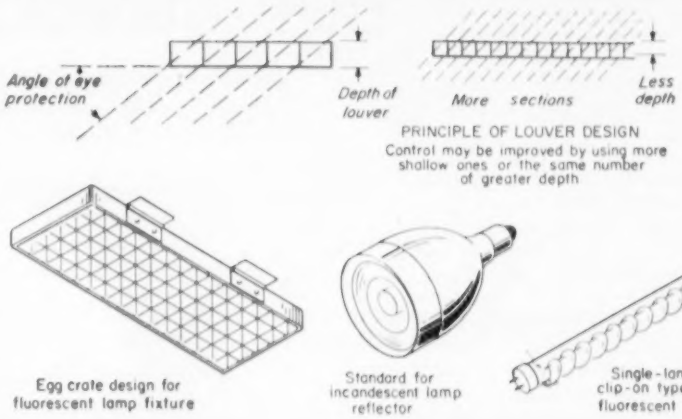
The lighting application engineer usually selects luminaires or lighting control devices which have already been designed by the lighting equipment designer. But he should nevertheless be thoroughly familiar with all light control principles. This knowledge will be helpful in selecting equipment or control devices most suitable for the lighting systems which he designs. Also, in some instances he may find it desirable to use control principles in equipments combined with architectural elements of the building, or in furniture, store fixtures and other interior furnishings. Reflectors may be installed in wall urns, for example, or in floor pedestals, coves, and luminous or architectural elements. In each case it is important to know exactly what type of control device is most appropriate, and why.

Light control principles actually extend beyond the luminaires, lighting equipment, reflectors, diffusers, louvers, etc. These might be classed as the primary control devices. The secondary light control devices would then include all the surfaces in the area on which light falls after leaving the primary control devices. Light directed to the ceiling from a suspended luminaire, for example, will be reflected from that ceiling according to the reflection characteristics of the ceiling. Similarly, light directed downward to a desk top, or production machine, will be controlled in its secondary reflection from such surfaces according to the reflection characteristics of these surfaces.

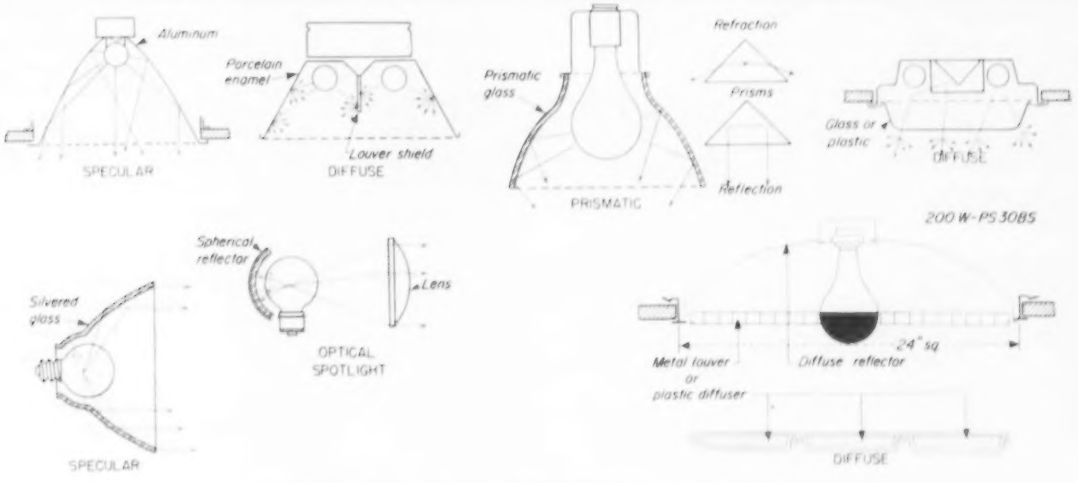
With the trend continuing to built-in and concealed types of lighting equipments, it becomes more and more important to take into consideration in lighting system design the secondary control of light from these secondary surfaces. It is important not only from the standpoint of light flux distribution, but also from the standpoint of change in color spectral characteristics of the initial light output as it is affected by color of the various interior surfaces, and from the influence on lighting quality as affected by light control characteristics of these surfaces.

Intelligent analysis of color values and surface reflection characteristics of any interior area will aid in selection of an appropriate light source and a quality lighting job.

LOUVERS CONTROL LIGHT BY SHIELDING


Angle of eye protection
Depth of louver
More sections
Less depth
PRINCIPLE OF LOUVER DESIGN
Control may be improved by using more shallow ones or the same number of greater depth
Egg crate design for fluorescent lamp fixture
Standard for incandescent lamp reflector
Single-lamp clip-on type for fluorescent lamp

LIGHT CONTROL DEVICES APPLIED TO LIGHTING EQUIPMENT



LIGHT SOURCES

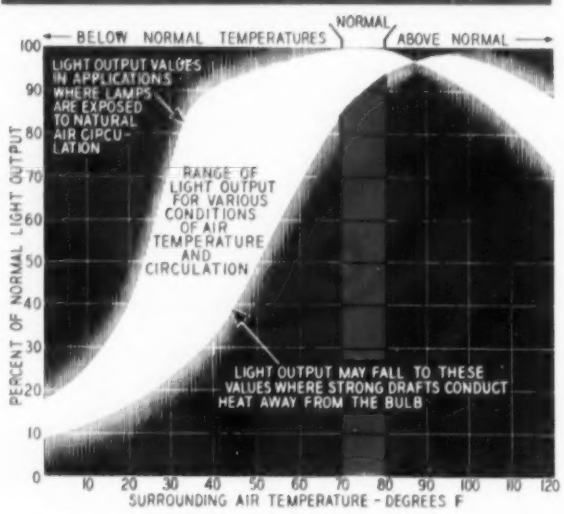
THE heart of any lighting system is the light source, the device that converts electric energy into light. The overall efficiency of the lighting system is primarily dependent upon the efficiency of the light source in producing light. It is therefore highly important that the lighting engineer select the light sources he proposes to use with intelligence and care.

Listed on these two pages are the standard light sources normally used for general lighting purposes. These light sources probably account for 90% or more of those in use today for providing general illumination in commercial and industrial interiors. The listings here are not intended to be complete, but it will be found in practice that the lamps selected for most lighting requirements will be found in these lists. Every lighting engineer, electrical contractor, consulting electrical engineer, electric utility lighting specialist, or electrical distributor lighting representative should maintain in his lighting file an up-to-date listing of all general service type light sources.

There are many factors to be considered in selecting the light source for any specific general lighting application. These include color quality of the light, total light output of the lamp, physical size of the lamp, lamp life, lumen depreciation throughout life, efficiency of converting electrical energy into light, stroboscopic effect, normal method of light control, amount of heat produced, ease of lamp replacement, cost and effect of ambient temperature surrounding the light source on its efficiency. Light sources normally used for general lighting include incandescent, fluorescent and mercury vapor.

Incandescent lamps are point sources of light, and light distribution can be controlled fairly accurately. Rated average life is low —750 hours for small lamps, 1000 hours for large lamps, and 2000 hours for certain industrial type lamps. Light output is not affected by changes in ambient temperature, but varies rapidly with changes in voltage (approximately 3 to 1 ratio). Color of light produced is slightly yellowish.

TEMPERATURE AFFECTS LIGHT OUTPUT OF FLUORESCENT LAMPS


BELOW NORMAL TEMPERATURES
NORMAL
ABOVE NORMAL
LIGHT OUTPUT VALUES IN APPLICATIONS WHERE LAMPS ARE EXPOSED TO NATURAL AIR CIRCULATION
RANGE OF LIGHT OUTPUT FOR VARIOUS CONDITIONS OF AIR TEMPERATURE AND CIRCULATION
LIGHT OUTPUT MAY FALL TO THESE VALUES WHERE STRONG DRAFTS CONDUCT HEAT AWAY FROM THE BULB
PERCENT OF NORMAL LIGHT OUTPUT
100
90
80
70
60
50
40
30
20
10
0
10 20 30 40 50 60 70 80 90 100 110 120
SURROUNDING AIR TEMPERATURE - DEGREES F

Source: G. E. Co., Nela Park

Fluorescent lamps are line sources of light, and are excellent for diffuse light distribution. Their light output cannot be controlled as accurately as that from incandescent lamps, especially in the T12 and T17 type lamps. More accuracy of control is possible with T6 and T8 lamps, however.

Rated average life of fluorescent lamps is a function of the frequency of starting the lamps, rather than number of hours operated, as is the case with incandescent lamps. The chart on the page opposite gives complete data on operating life. Fluorescent lamps are characteristically long life lamps.

FLUORESCENT LAMP LUMEN OUTPUT RATIOS

(Standard Cool White = 1.00)

Color of Lamp	Multiplying Factor
Deluxe Cool White	0.71
Deluxe Warm White	0.71
Daylight	0.93
Soft White	0.68
Green	1.20
Gold	0.60
Blue or Pink	0.45
Red	0.06

Fluorescent lamps are available in several "white" types for general lighting purposes, and in a number of colored types. The "white" lamps include soft, warm, standard (3500° K), cool (4500° K), daylight, deluxe warm and deluxe cool. The deluxe lamps have a spectral color balance which helps to offset the characteristically blue-green color effect of uncorrected fluorescent lamps.

The light output range per fluorescent lamp has now increased up to 13,000 lumens, for the 8-foot T17 VHO or PG lamps, newest additions to the line.

Mercury vapor lamps have long lamp life, averaging 6000 hours, are more than double the efficiency of incandescent lamps, have approximate point source for accurate light control, and have been greatly improved in color quality. These lamps provide high light output per lamp, and are available in a range of sizes to meet a variety of lighting applications. Their use is increasing in industrial and floodlighting applications and in street and highway lighting.

STANDARD INCANDESCENT LAMPS

Watts	Bulb	Initial Lumens	Initial LPW	Rated Life (Hours)	Light Center Length
100	A19	1740	17.4	750	3⅛
150	A23	2700	18.0	750	4⅝
200	A25	3800	19.0	750	5¼
300	PS30	5950	19.8	750	6
500	PS40	9900	19.8	1000	7
750	PS52	16700	22.3	1000	9½
1000	PS52	23000	23.0	1000	9½
1500	PS52	33000	22.0	1000	9½
750	T24*	14200	19.0	1000	5½
1000	T24*	20000	20.0	1000	5½

*Special heat-resistant glass bulb, inside frost, with medium bipost base for base-up burning.

NOTE — For complete listing, see lamp manufacturers' catalogs. All lamps listed above are inside frost general service type lamps.

Source: Manufacturers of lamp bulbs.

STANDARD FLUORESCENT LAMPS

Lamp Designation	Nominal Length (Inches)	Ave. Lamp Amps.	Light Output* Total Lumens	Light Output* L/W	Brightness* Foot-lamberts
Preheat Start Lamps (Starters Required)					
F20T12	24	0.38	1000	51	1600
F25T12	33	0.49	1600	62	1800
F30T8	36	0.36	1890	63	2900
F40T12	48	0.43	2500	64	1900
F90T17	60	1.55	5150	57	2250
Rapid Start Lamps (No Starters Used)					
F40T12/RS	48	0.43	2500	64	1900
High Output, VHO, Power Groove Lamps					
F48T12/HO	48	.80	3250	54	2600
F72T12/HO	72	.80	5200	61	2650
F96T12/HO	96	.80	7300	70	2700
F48PG17	48	1.50	6000	56	4100
F72PG17	72	1.50	9300	70	4050
F96PG17	96	1.50	13000	65	4100
Slimline Lamps (Instant Start)					
F48T12	48	.425	2300	61	1850
F72T12	72	.425	3600	65	1800
F96T12	96	.425	5050	68	1850

*Initial Values, based on cool white lamps.

Source: Catalogs of lamp manufacturers.

COLD CATHODE FLUORESCENT LAMPS

Lamp Designation	Length Nominal (Inches)	Lamp Wattage*	Initial Lumens** 4500° White	L/W*
2545	48	26	1000	38.5
2552	55	29	1150	39.7
2564	67	31	1250	40.2
2569	72	34	1600	47.0
2572	75	36	1700	47.2
2584	87	40	2050	51.2
2593	96	42	2200	52.4

*Wattage and lumens per watt (L/W) for lamp only. Add watts loss in transformers for total watts and overall efficiency.

**Low pressure lamps operated at 120 ma.

Source: Fluorescent Lighting Association Handbook.

RATED AVERAGE LIFE OF FLUORESCENT LAMPS

Type Lamps	Burning Hours Per Start: 3	6	12	Continuous*
Starter-Operated (15, 20, 25, 30, 32 40, 90 and 100-watt)	7,500			
Rapid Start	7,500	Plus	Plus	Plus
All T12 Slimline	7,500	25%	60%	250%
T6 and T8 Slimline	6,000			
Cold Cathode LP	15,000	Life not affected by number of starts		
Cold Cathode HP	25,000			

*Light output depreciates steadily as lamps are burned. Where infrequent starting or continuous burning is involved, lamps should be replaced before they reach average life, for greatest lighting value.

Source: Manufacturers of fluorescent lamps.

STANDARD MERCURY VAPOR LAMPS

Lamp Designation	Approximate Watts*	Bulb	Light Center Length	Approximate Lumens**	L/W*
H100-M4	100	PS-25	5 in	3,300	33.0
H175-C22	175	BT-28	5 in	6,700	38.3
H250-J5	250	BT-28	5 in	10,500	41.9
H400-J1	400	BT-37	7 in	20,000	50.0
H400-RC1	400	R-52	—	20,500	51.3
H400-E1	400	BT-37	7 in	21,000[n]	52.4
H400-E1T	400	T-20	7 in	20,000[n]	50.0
H700-A18	700	BT-46	9½ in	35,000[n]	50.0
H700-B18	700	BT-46	9½ in	33,000	47.2
H1000-C12	1000	BT-56	9⅜ in	51,500	51.5
H1000-RC15	1000	BT-56	9⅜ in	53,000	53.0
H1000-A15	1000	BT-56	9⅜ in	54,000[n]	54.0
H3000-A9	3000	T-9½	—	132,000	44.0

*Lamp only, does not include transformer watts loss.

**Initial, using color improved lamps, except marked ([n]).

Source: Manufacturers of light sources.

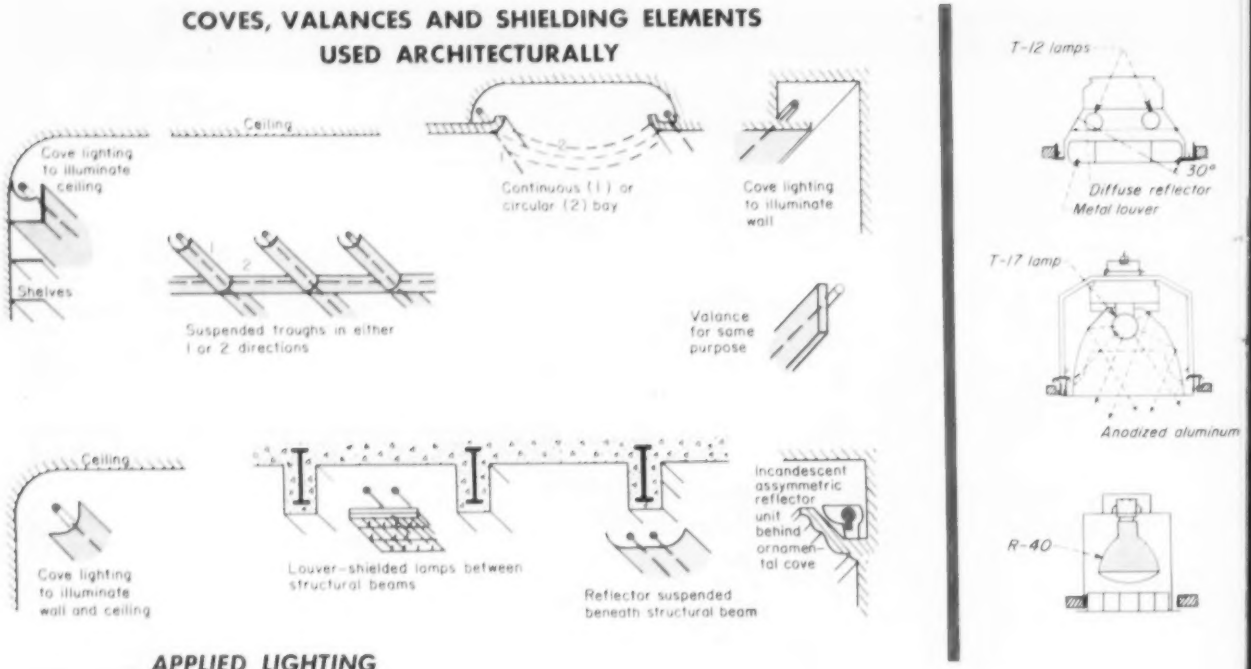
PROJECTOR AND REFLECTOR LAMPS

Bulb Type	Watts	Beam Spread (Degrees)*	Beam Lumens*	Candlepower (10° Cone)**
Spot Beam Type				
PAR38	75	30 x 30	480	4,000
R30	75	50	400	1,800
PAR38	150	30 x 30	1100	10,500
R40	150	40	810	6,000
PAR46	200	17 x 23	1200	30,000
PAR46	200	20 x 40	1300	11,000
PAR56	200	10 x 10	—	260,000
PAR56	300	15 x 20	1800	70,000
PAR56	300	20 x 35	2000	22,000
R40	300	35	1800	13,500
PAR64	500	13 x 20	3000	110,000
PAR64	500	20 x 35	3400	35,000
R40	500	35	3100	22,000
Flood Beam Type				
R20	30	85	144	290
PAR38	75	60 x 60	600	1,700
R30	75	130	610	430
PAR38	150	60 x 60	1350	3,400
R40	150	110	1500	1,250
PAR56	300	35 x 65	2100	10,000
R40	300	115	2800	2,700
PAR64	500	35 x 65	3500	12,000
R40	500	115	5400	5,200

*Measured to 10% of maximum candlepower.

**Average initial CP in 10° cone.

Source: Manufacturers of light sources.



LIGHTING SYSTEMS

TYPES OF LUMINAIRES

TYPE OF LIGHT DISTRIBUTION	LUMINAIRE DESCRIPTION
DIRECT (D)	a. Suspended b. Surface mounted
SEMI-DIRECT (SD)	c. Recessed d. Concealed (coffer, soffit)
GENERAL DIFFUSE (G)	e. Luminous ceilings f. Luminous elements
SEMI-INDIRECT (SI)	g. Architectural elements h. Pedestal or floor mounted
INDIRECT (I)	i. Wall mounted j. Cove lighting k. Special ornamental

RECOMMENDED INTERIOR REFLECTANCES

Surface	Reflectance Range (%)
Ceiling	75 — 90
Upper walls	50 — 65
Trim	40 — 50
Machines	30 — 40
Lower walls	30 — 50
Furniture	25 — 40
Floors	15 — 30

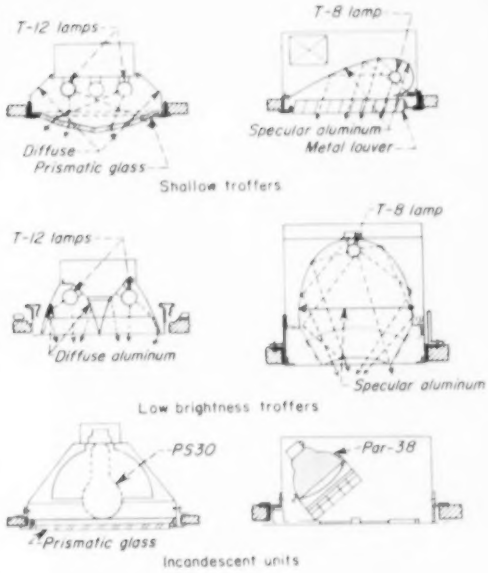
IT IS normal practice in the lighting industry to classify luminaires according to their light distribution characteristics. These characteristics have been divided into five general types, based upon the percentage of light directed upward or downward from the center of the luminaire, and have been approved and adopted by the International Commission on Illumination (ICI). All luminaires can be classified according to these five types of light distribution.

A lighting system is made up from one or more types of luminaires, or types of lighting equipment. While there are literally hundreds of luminaire designs available, it has been found that these designs can be grouped under general broad classifications, each of which may be described or defined as a "lighting system". For example, there are a wide variety of troffer designs available—deep, shallow, open, louvered, diffuser or lens panel equipped, etc.—but they all fall under the classification of troffers, and are recessed. They may therefore be classified as a recessed troffer lighting system. The five types of light distribution (ICI) and several of the broad classifications of luminaires are listed in the table at left, titled "Types of Luminaires".

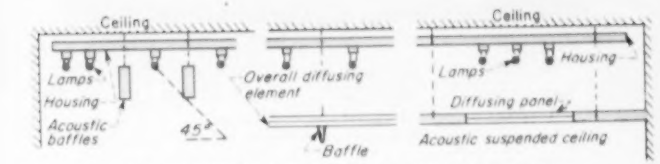
Also shown on these two pages are several types of luminaires and lighting equipment. While the types shown are limited, those included do indicate the wide range of types of luminaires and lighting equipment which are available and in general use today.

In selecting a lighting system for any specific lighting installation, the selection will be controlled principally by the lighting result desired, and by ornamental and decorative considerations. On new construction projects, the lighting engineer will usually be free to specify any type of lighting system selected, including recessed and concealed systems. But on relighting projects, it may not be practical or possible to use certain types of built-in lighting systems. Also, on relighting projects, capacity of the existing wiring system may limit both the footcandle intensities and the type of lighting system which may be used. Solution of such problems requires either that the building be rewired or that a highly efficient type of lighting system be used. In some cases it may be possible to repaint the ceiling and side walls in lighter

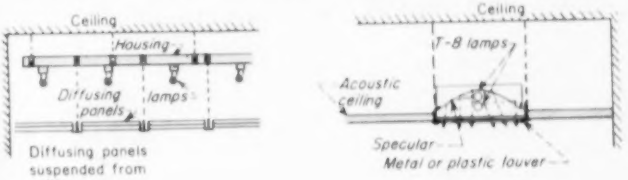
RECESSED LUMINAIRES

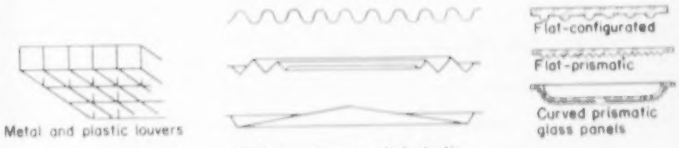


TRANSLIGHTED CEILING AREAS



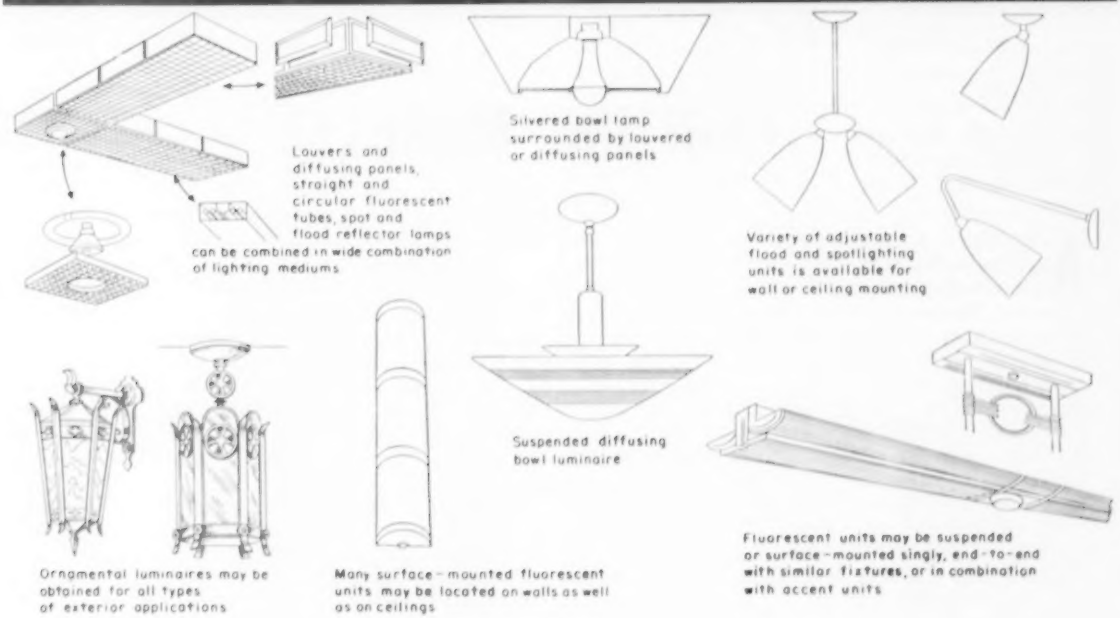
Diffusing, shielding and baffling elements suspended directly from ceiling





DIFFUSING SHIELDING ELEMENTS

SURFACE MOUNTED AND SUSPENDED LUMINAIRES


Louvers and diffusing panels, straight and circular fluorescent tubes, spot and flood reflector lamps can be combined in wide combination of lighting mediums
Silvered bowl lamp surrounded by louvered or diffusing panels
Variety of adjustable flood and spotlighting units is available for wall or ceiling mounting
Suspended diffusing bowl luminaire
Ornamental luminaires may be obtained for all types of exterior applications
Many surface-mounted fluorescent units may be located on walls as well as on ceilings
Fluorescent units may be suspended or surface-mounted singly, end-to-end with similar fixtures, or in combination with accent units

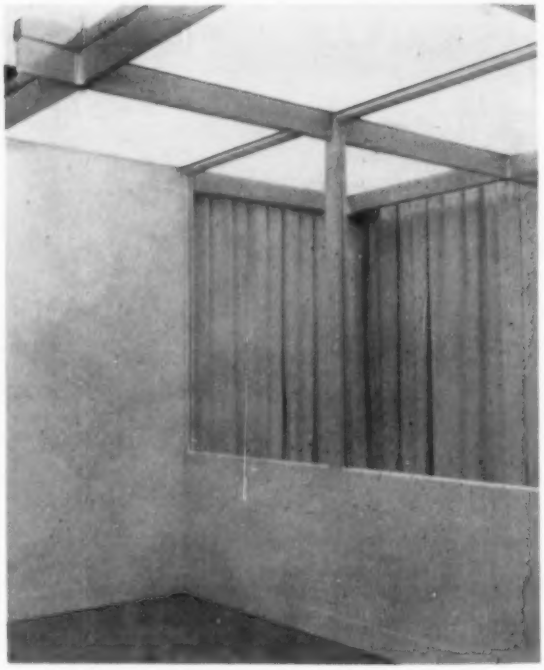
colors and use a lighting system that is appropriate for the lighting problem and wiring capacity involved.

The lighting system used should be architecturally appropriate for the area, and every effort should be made to combine the lighting system layout with the structural details to present the most harmonious appearance possible. Lighting engineers have long advocated that light and lighting equipment be combined with architectural treatment to create a harmonious and pleasing design treatment. The current trend to use more and more built-in types of lighting systems seems to indicate that architects have finally realized that light can be and is, when properly integrated, a highly effective design tool. This is true for either the integration of specific types of luminaires, or the incorporation of patterns of highlights and shadows as a part of the lighting result.

MODULES FOR LIGHTING

Basic Module Dimension (Inches)	Building Module (Inches)	Luminaire Module (Inches)	Basic Lamps
12		12	Inc.*
16		16	Inc.*
24	24	24	F20T12
		2/12	
32	32	32	F96T12
		2/16	Inc.*
36	36	36	F-30T12
		3/12	F72T12
			Inc.*
48	48	48	F40T12
		2/24	F48T12
		3/16	F96T12
		4/12	Inc.*
60	60	60	F40T17
64		2/32	F96T12
			Inc.*
72	2/36	2/36	F72T12
96	2/48	96	F96T12
	3/32	2/48	F40T12
	4/24	3/32	F48T12
		4/24	Inc.*

*Incandescent lamps in reflector over prismatic lens, diffuser, or louver.



BUILDING MODULE shown here is set by luminous ceiling design which is arranged for wall partitions or sound baffles on 48-in. centers.

APPLIED LIGHTING

LIGHTING MODULES

A GROWING trend among architects is to design building structures around a modular fixed dimension. There are several reasons for this trend. For one, it permits a degree of standardization of most building materials and equipment—windows, doors, movable partitions, acoustical materials, flooring, bathroom fittings and fixtures, office furniture, etc.—and thus helps to reduce building costs.

Manufacturers of fluorescent lighting equipment have had experience with modular dimensions, but for different reasons. Light source manufacturers set up modules for fluorescent lamps soon after they were introduced, to provide a degree of standardization and to eliminate confusion. Fluorescent lamp modules are basically 12 inches, although as the length of lamps has increased, the 24-inch dimension is growing in popularity. Another fluorescent lamp module, which has not proved very popular is 18 inches (15 and 30 watts T8 lamps). Thus manufacturers of fluorescent luminaires, and especially of continuous row equipment, have had to adopt modular dimensions for their design, based on the fluorescent lamp modules.

Now, with modular treatments being adopted for complete building structures, and with built-in, recessed, and luminous ceiling lighting systems being used for lighting these structures, it becomes necessary for lighting equipments to also be designed around the same module dimensions. From a practical standpoint, actually, the building module selected must conform to some dimension for which fluorescent lamps are available, if this efficient and economical light source is to be used most effectively for lighting.

An effort has been made to correlate and show the relationship of building modules, luminaire modules and basic light sources to basic module dimensions which are possible with light sources and lighting equipment. This correlation is shown in the table above. The data given are not necessarily complete. But it is believed that a study of these data by anyone faced with the problem of establishing a building module will be helpful.

Two recent large buildings in particular are of interest, because of their modular treatment. The module for each was selected after much study and analysis of the occupancy module for partitions and furniture arrangements and of the integrated lighting system. One is the group of buildings at the new General Motors Technical Center, Warren, Mich., in which a five-foot module was used. The other is the new Connecticut General Life Insurance Company building in Bloomfield, Conn., where a six-foot module was used.

LUMINAIRES

THE lighting objective for a specific lighting installation is established through an analysis of the lighting problem involved. Then luminaires are selected which will most adequately meet that objective. Many factors should be considered in making this selection. Some of the more important factors are listed in the check chart (right), and described briefly. All of these factors are important, and none should be overlooked. Thus the final selection rests on how well a luminaire satisfies the requirements for each factor, in a composite summary of the several factors involved.

On certain types of lighting installations, there will of course be other considerations. Many of today's lighting jobs use luminous ceilings and large-area low-brightness recessed units. Quite often the building structure incorporates a building module dimension. In such installations, it will also be necessary to conform the equipment dimensions to the module dimensions, and to check ventilation and ambient temperatures around the fluorescent lamps, to insure maximum efficiency of light output. Ambient temperature should be checked on all types of fluorescent luminaires, but especially on enclosed and recessed types. Also, when luminaires are to be recessed, it is important to check structural details of the building, recessing depth available, the location of beams, pipes, air ducts, etc.

When a lighting system is based on suspended type luminaires, either of the indirect, semi-indirect, general diffuse, or semi-direct type, the suspension length should be chosen carefully. It is desirable to light the ceiling as uniformly as possible, also to keep the bottom of the luminaires as high above the work plane as possible. Often it will be necessary to make compromises when using such luminaires, but it should be kept in mind that overall suspension should be no greater than necessary to give a reasonably uniform ceiling brightness.

HOW TO ANALYZE AND SELECT LUMINAIRES

Select for . . .	Comments
Type of Light Source	Consider lumens per watt, size of lamps, color quality of light produced by the lamps, lamp life, and replacement cost.
Type of Light Distribution	The type of lighting system and equipment layout selected will control the type of light distribution required for the luminaires or reflector equipment.
Initial Lumens Required	Light loss factors, spacing of outlets, and the desired lighting intensity maintained in service will establish light output in lumens required for each luminaire.
Overall Efficency	Overall efficiency of luminaires varies from a high of approximately 90%, downward. Consult manufacturers' light output and photometric data for luminaires under consideration.
Quality of Materials	Reflectors should have permanent type reflecting surface. Diffusing media should be durable, highly translucent, and should present an evenly lighted appearance. Gauge of metals should be adequate for necessary rigidity. Proper ventilation is important.
Ease of Maintenance	Luminaires should be easy to clean and relamp, with easily removable louvers, diffuser panels, etc. Ballasts should be readily accessible.
Appearance	Luminaires should have clean, crisp lines, should present a good appearance, and harmonize with interior and architectural treatment. Plain, simple lines are usually preferred.
Cost	Equipment cost is only part of the cost of good lighting. High first cost of equipment in a well designed lighting system may readily provide low overall cost of lighting. Consider operating and maintenance costs as well as first cost of equipment, then select a low-cost "system".

All luminaires should be designed to provide maximum visual comfort. That is, the light sources should be shielded to prevent direct glare when the luminaire is in the normal field of vision. Luminaires should also prevent or minimize reflected glare, especially those selected to light offices, classrooms and drafting rooms.

Depending on the type of area to be lighted, and its physical dimensions, it is sometimes more practical to first select the type of luminaire which is preferred, and then to plan the equipment layout around the light distribution of the luminaires selected. This procedure has the advantage of making it possible to use a particular type of luminaire, and of adapting the layout to meet the necessary conditions imposed by the lumen output and light distribution characteristics of the luminaire. When the appearance of the physical layout and arrangement of luminaires is of greater importance, the equipment layout should be made first, and luminaires then selected to meet these requirements.

Reflector materials and finishes are important. The materials should be such that the reflecting surface is permanent and will not deteriorate from excessive heat and repeated cleanings. Finishes should be proper for producing the type of light distribution required, and for good appearance.

EQUIPMENT LAYOUTS

THE lighting engineer is in the enviable position of having an almost endless variety of luminaires, lighting equipments and devices, which can be laid out in an almost equally broad range of patterns and combinations, to light any interior area. He can range all the way from a simple symmetrical arrangement of a single type of unit to a complicated unsymmetrical arrangement, using a variety of different types of units. Generally, the simple symmetrical arrangements are preferred for most general lighting applications, especially in industrial production areas, offices, drafting rooms, school classrooms, and similar utilitarian areas. But in stores, especially in specialty shops, dining areas, hotel lobbies, reception rooms, and areas where light becomes a part of the decorative treatment, variety and individuality in equipment layout is often appropriate and preferred.

Typical lighting layouts, and pattern arrangements of various types of luminaires, are shown in the illustrations on the following page. These are presented to serve as a reminder to the lighting designer of some of the possible arrangements and combinations. These sketches are self-explanatory. Designers who like individuality in lighting layout will work out many other good arrangements, making use of still other types of equipment not included in the illustrations shown.

In general, modern lighting equipment is of three basic types: round, linear and area sources. Round units vary from 6-inch diameter units to large circular domes. Units up to 18 inches in diameter usually use incandescent lamps, larger sizes use fluorescent lamps. Linear equipment varies from a single bare fluorescent lamp on a channel to 36-inch wide equipment, usually fluorescent, connected to form continuous rows of lengths required. Area sources range from individual 24-inch square units all the way up to wall-to-wall louverall and luminous ceiling treatments. Fluorescent lamps are normally used with area sources.

Some of the cardinal points to keep in mind when making a lighting equipment layout are summarized in the table (below) giving "Layout Reminders". Spacing dimensions for typical luminaires are also given in the chart at right.

LAYOUT REMINDERS
For the Lighting System Designer

- *A customer buys a lighting system to provide an adequate, comfortable and appropriate lighting result* — not because he wants luminaires, lamps, conduit and wiring.
- *Luminaires and lighting equipment selected should be appropriate for the structure and the seeing problems involved.* Appearance, functional design, direct and reflected glare, shadows, maintenance, and lighting efficiency are all factors to be considered.
- *The lighting layout should fit the structural details of the building.* If plans and drawings are not available, survey the interior and note location of columns, beams, obstructions and other architectural features.
- *Use conventional layouts with symmetrical spacing of units,* if possible, with luminaires parallel and perpendicular to walls. Special geometrical patterns may be suitable in some cases but should be avoided generally unless they serve a specific functional or design purpose.
- *Use continuous-row fluorescent luminaires in preference to individual units.* The completed installation will look better and usually results in economies in wiring and installation.
- *Recessed and built-in lighting equipment does not light the ceiling.* Check your layout and room surface reflectances to see that use of such equipment will not produce uncomfortably dark ceilings nor excessive brightness ratios in the normal field of view.
- *Efficiency of trans-lighted ceilings is dependent to a great extent on the reflectance of the plenum cavity.* Be sure lamps can be mounted sufficiently high above diffusers or louvers to provide uniform brightness and spaced properly to provide desired intensity. Paint entire cavity white with highest possible reflectance.
- *Suspended luminaires of the direct-indirect type often produce the best lighting result most economically.* Check the suspension length carefully and limit it to the dimension which gives reasonably uniform ceiling brightness.
- *Luminaire spacings should be used which produce uniform illumination* and prevent undesirable shadows.
- *Flexible lighting layouts which will permit more luminaires or lamps to be added later* should be planned. This will permit an increase in lighting intensity without spoiling the symmetry or architectural harmony of the initial installation.
- *Plan the maintenance program along with the lighting layout.* Be sure that all luminaires and lighting equipment are easily accessible and are designed to be cleaned easily and quickly.
- *Consider the finish and reflection factor of ceiling and side walls.* Recommend proper colors and finishes to provide surrounding brightness conditions which promote eye comfort and good seeing conditions.
- *Double check all calculations and details* to insure the proper number of units and the ultimate desired lighting result.

LUMINAIRE MOUNTING AND SPACING

COMMERCIAL — INDUSTRIAL

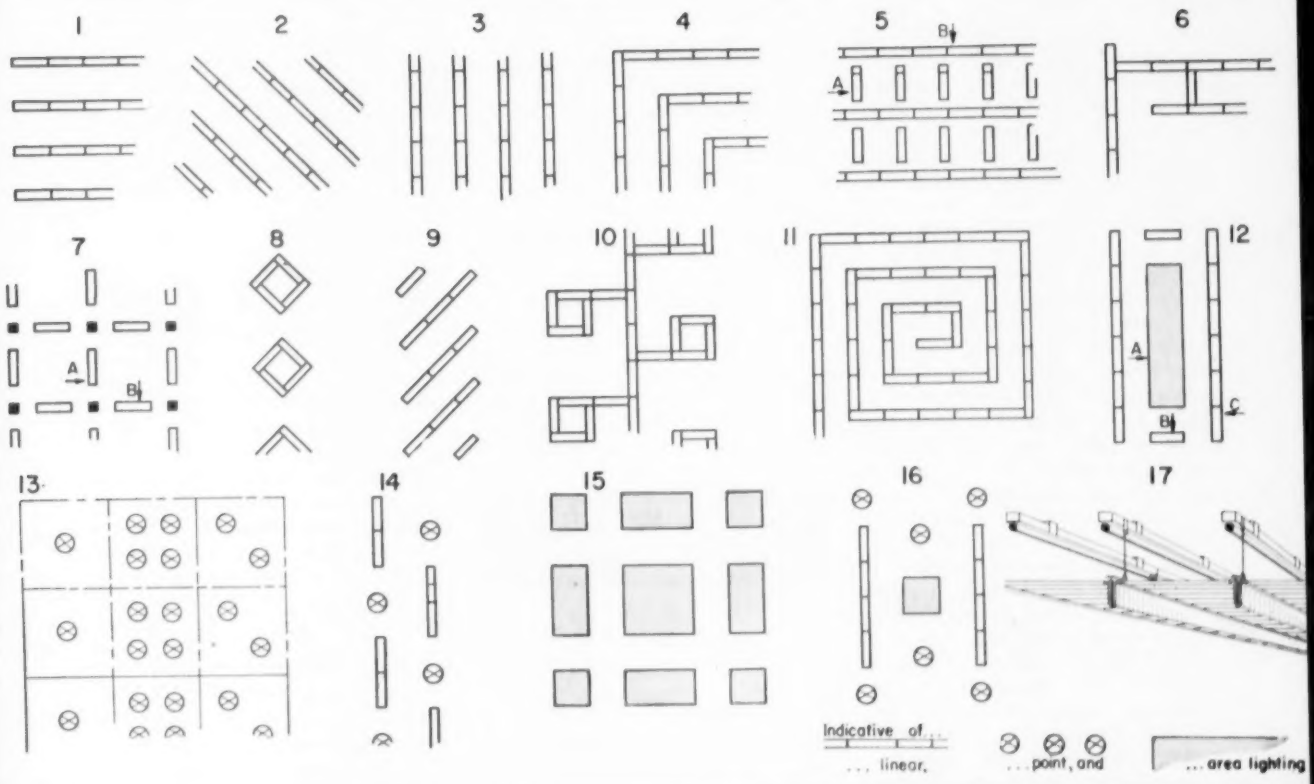
Mounting Height of Luminaire / Ceiling Height for Indirect and Semi-Indirect Luminaires	Direct	Semi-Direct	Semi-Indirect	Indirect	Spread	Concentrating
	D	SD	SI	I		

Dimensions in Feet	Max. Spacing Between Units	Spacing * from Walls	Spacing Between Units	Length of Suspension
8	7½	3	9	1-3
9	8	3	9½	1½-3
10	9	3½	10½	2-3
11	10½	3½	12	
12	12	4	14	2½-4
14	15	5	17	3-4
16	19	6	21	4-5
20 or more	24	7	26	4-6

Maximum Spacing[1] (ft.)		
Mounting Heights Above Floor	Spacing Between Units	
	Spread	Concen't.
15	12	—
16	12	—
18	18	—
20	20	—
24	23	16
30 or more	30	20

*Spacings apply where desks or benches are next to wall, otherwise one-half the spacing between units is satisfactory.
[1]Units may have to be spaced closer to obtain desired illumination values.

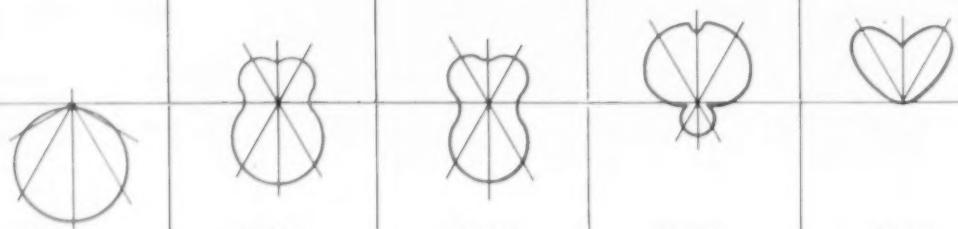
TYPICAL LAYOUTS FOR GENERAL LIGHTING



LIGHTING CALCULATIONS

LIGHTING SYSTEM CLASSIFICATIONS

	Type D	Type SD	Type G	Type SI	Type I
UP	0-10%	10-40%	40-60%	60-90%	90-100%
DOWN	90-100%	60-90%	40-60%	10-40%	0-10%
	Direct	Semi-Direct	General Diffuse	Semi-Indirect	Indirect



THE lighting engineer has at his disposal a wealth of lighting design data and formulas which enable him to make reasonably accurate calculations of lighting results for a given set of installation conditions, light sources, luminaires, mounting heights, and other design details. Such calculations are simple and easy to make, and the data available are easy to interpret and understand.

Lighting calculations are important, and for several reasons. Customers like to know "how much light" they are buying when they buy and install a specific type of luminaire or lighting system. It is possible to calculate the results in advance, when the job is in the design stage. Lighting engineers also like to make cost analyses of one system versus another, and by using basic design data it is possible to reduce each lighting system to a common denominator, for purposes of comparison.

Different formulas and different design principles are used to calculate the average number of lumens per square foot (lighting intensity in footcandles) for different types of lighting. The types of lighting and methods in general use for predetermining the lighting intensity which will result are: general lighting — the lumen method; supplementary lighting—the point-by-point method and the lumens-per-foot method; floodlighting—the beam-lumens method; and street lighting—isocandle curves. All of the above calculation methods focus on the footcandle design objective. There are also other objectives, such as brightnesses and visual comfort objectives, with their own formulas and calculation procedures. These are covered elsewhere in this article.

Calculations pertaining to average general illumination only, as made by the lumen method, are considered here. Thus only the formulas relating to general lighting design are given, plus basic reference data applying to some of the more popular types of luminaires. These data are intended primarily for quick reference by lighting engineers who are fairly familiar with basic lighting design principles, and who will be able to make appropriate allowances for design variables, or interpolate for intermediate values in the condensed data given. For greater accuracy the engineer should consult the specific performance data for a specific type of luminaire under consideration, as reported by the manufacturer.

LIGHTING DESIGN FORMULA
(Zonal Lumen Method)

$$FC = \frac{\text{Total initial lamp lumens} \times CU \times MF}{\text{Area (sq. ft)}}$$

FC = Average footcandles
CU = Coefficient of utilization
MF = Maintenance factor

The lumen method formula for general lighting calculation is shown at bottom of this page. It can be restated in a number of ways and used to determine any one of the factors when the other factors are known.

Lighting levels for seeing tasks of varying severity are given in the chart under "How Much Light" on a preceding page.

Initial lamp lumens for the popular types and sizes of light sources —incandescent, fluorescent, and mercury vapor—are given in tables under "Light Sources", also on a preceding page.

Coefficient of utilization values for some of the basic types of luminaires, classified according to type of light distribution (see chart at top of this page) are given on this and the following two pages. In order to use the coefficient of utilization tables, it is also necessary to know and understand "Room Ratios", which are given for a broad range of room sizes and proportions in the table on the page opposite. Also given on the page opposite are the formulas for

determining room ratio for any given size room.

Area for a room is expressed in square feet in the formula, and is the length times the width.

The final factor in the formula is the maintenance factor. This factor represents the allowance that must be made to offset lamp depreciation and the effect of dust and dirt accumulation on equipment between cleaning periods. An allowance of 20% to 40%, depending on dust and dirt conditions, is considered appropriate. Thus the MF will range from .60 to .80 accordingly. Manufacturers normally give values for specific luminaires.

ROOM RATIOS

Room W ft	Room L ft	Height of Light Source above Floor 8	10	12	15	19	27	43
10	10	0.9	0.7	0.5				
	14	1.1	0.8	0.6	0.5			
	18	1.2	0.9	0.7	0.5			
	24	1.3	0.9	0.7	0.6			
	30	1.4	1.0	0.8	0.6			
14	14	1.3	0.9	0.7	0.6			
	20	1.5	1.1	0.9	0.7	0.5		
	30	1.7	1.3	1.0	0.8	0.6		
	40	1.9	1.4	1.1	0.8	0.6		
	60	2.1	1.5	1.2	0.9	0.7	0.5	
18	20	1.7	1.3	1.0	0.8	0.6		
	30	2.0	1.5	1.2	0.9	0.7		
	40	2.3	1.6	1.3	1.0	0.8	0.5	
	60	2.5	1.8	1.4	1.1	0.8	0.6	
	80	2.7	2.0	1.5	1.2	0.9	0.6	
25	30	2.5	1.8	1.4	1.1	0.8	0.6	
	40	2.8	2.1	1.6	1.2	0.9	0.6	
	60	3.2	2.4	1.9	1.4	1.1	0.7	
	80	3.5	2.5	2.0	1.5	1.2	0.8	0.5
40	40	3.6	2.7	2.1	1.6	1.2	0.8	0.5
	60	4.4	3.2	2.5	1.9	1.5	1.0	0.6
	80	4.9	3.6	2.8	2.1	1.6	1.1	0.7
	100	5.2	3.8	3.0	2.3	1.7	1.2	0.7
60	60	5.5	4.0	3.2	2.4	1.8	1.2	0.8
	100	6.8	5.0	3.9	3.0	2.3	1.5	0.9
	140	7.6	5.6	4.4	3.4	2.6	1.7	1.0
80	80	7.3	5.3	4.2	3.2	2.4	1.6	1.0
	140		6.8	5.4	4.1	3.1	2.1	1.3
	200		7.6	6.0	4.6	3.5	2.3	1.4
100	100		6.7	5.3	4.0	3.0	2.0	1.2
	150			6.3	4.8	3.6	2.5	1.5
	200			7.0	5.3	4.0	2.7	1.6

ROOM RATIO FORMULA

For Direct, Semi-Direct and General Diffuse Lighting:

$$RR = \frac{W \times L}{H \times (W + L)}$$

For Semi-Indirect and Indirect Lighting:

$$RR = \frac{3 \times W \times L}{H \times (W + L)}$$

W = Width of room

L = Length of room

H = Luminaire height above work plane for direct lighting; ceiling height above work plane for indirect lighting

ROOM INDEX TO ROOM RATIO CONVERSION

RI —	A	B	C	D	E	F	G	H	I	J
RR —	5.0	4.0	3.0	2.5	2.0	1.5	1.25	1.0	0.8	0.6

COEFFICIENTS OF UTILIZATION FOR TYPICAL LUMINAIRES

Direct Lighting

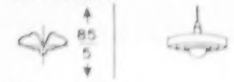
DISTRIBUTION / LUMINAIRE	CEILING	80%		50%	
	WALLS	50%	30%	50%	30%
	ROOM RATIO	COEFFICIENTS OF UTILIZATION			
Flux ratio .365	4.0	0.80	0.76	0.77	0.74
	2.5	0.73	0.68	0.70	0.66
	1.5	0.63	0.56	0.61	0.55
	1.0	0.52	0.45	0.50	0.44
Flux ratio .605	4.0	0.70	0.68	0.68	0.67
H400-E1,-A1 H1000-A15,-A12	2.5	0.67	0.64	0.65	0.63
	1.5	0.61	0.58	0.60	0.57
	1.0	0.54	0.50	0.53	0.50
Flux ratio .390	4.0	0.77	0.74	0.73	0.70
	2.5	0.71	0.66	0.66	0.63
	1.5	0.61	0.55	0.57	0.53
	1.0	0.50	0.44	0.47	0.42
Flux ratio .830	4.0	0.68	0.67	0.66	0.65
	2.5	0.66	0.65	0.64	0.63
	1.5	0.63	0.61	0.62	0.60
	1.0	0.60	0.58	0.59	0.57
Flux ratio .435	4.0	0.58	0.56	0.56	0.55
	2.5	0.54	0.51	0.52	0.50
	1.5	0.48	0.44	0.46	0.43
	1.0	0.41	0.36	0.39	0.35
Flux ratio .510	4.0	0.50	0.48	0.48	0.47
	2.5	0.47	0.44	0.45	0.44
	1.5	0.42	0.39	0.41	0.38
	1.0	0.36	0.33	0.35	0.32
Flux ratio .480	4.0	0.54	0.52	0.52	0.51
	2.5	0.51	0.48	0.49	0.47
	1.5	0.46	0.42	0.44	0.41
	1.0	0.39	0.35	0.38	0.34

Semidirect Lighting

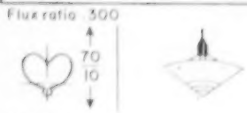
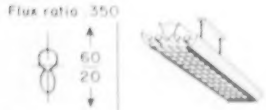
Flux ratio .480	4.0	0.69	0.66	0.61	0.59
	2.5	0.63	0.59	0.57	0.54
	1.5	0.55	0.50	0.50	0.46
	1.0	0.46	0.41	0.42	0.38
Flux ratio .335	4.0	0.56	0.52	0.50	0.48
	2.5	0.50	0.46	0.45	0.42
	1.5	0.42	0.38	0.38	0.35
	1.0	0.34	0.29	0.31	0.27

COEFFICIENTS OF UTILIZATION FOR TYPICAL LUMINAIRES

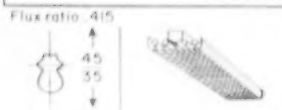
Indirect Lighting

DISTRIBUTION / LUMINAIRE	CEILING	80%		50%	
	WALLS	50%	30%	50%	30%
	ROOM RATIO	COEFFICIENTS OF UTILIZATION			
Flux ratio .265 	4.0	0.65	0.61	0.43	0.40
	2.5	0.58	0.53	0.38	0.35
	1.5	0.49	0.43	0.32	0.28
	1.0	0.39	0.33	0.26	0.22
Flux ratio .300	4.0	0.47	0.44	0.30	0.28
	2.5	0.43	0.39	0.28	0.25
	1.5	0.35	0.31	0.23	0.20
	1.0	0.28	0.24	0.18	0.16
Cove	4.0	0.36	0.34	0.22	0.21
	2.5	0.33	0.30	0.20	0.19
	1.5	0.25	0.21	0.15	0.13
	1.0	0.18	0.15	0.10	0.09

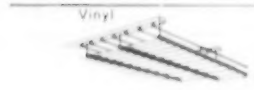
Semi Indirect Lighting

Flux ratio .300 	4.0	0.59	0.55	0.40	0.38
	2.5	0.53	0.48	0.36	0.33
	1.5	0.44	0.39	0.31	0.27
	1.0	0.36	0.30	0.25	0.21
Flux ratio .350 	4.0	0.58	0.55	0.42	0.40
	2.5	0.53	0.49	0.39	0.36
	1.5	0.45	0.40	0.33	0.30
	1.0	0.36	0.31	0.27	0.24

General Diffuse Lighting

Flux ratio .415 	4.0	0.60	0.57	0.49	0.46
	2.5	0.54	0.50	0.44	0.41
	1.5	0.45	0.41	0.38	0.34
	1.0	0.36	0.32	0.31	0.27
Flux ratio .450	4.0	0.61	0.58	0.49	0.48
	2.5	0.56	0.52	0.46	0.43
	1.5	0.47	0.42	0.39	0.36
	1.0	0.38	0.33	0.32	0.28
Flux ratio .445	4.0	0.52	0.50	0.44	0.42
	2.5	0.48	0.44	0.40	0.38
	1.5	0.41	0.37	0.35	0.32
	1.0	0.33	0.29	0.29	0.26

Luminous Ceiling Lighting

CEILING ELEMENTS	CAVITY	85%		75%	
	WALLS	50%	30%	50%	30%
	ROOM RATIO	COEFFICIENTS OF UTILIZATION			
Vinyl  Diffusers	4.0	0.59	0.56	0.51	0.49
	2.5	0.52	0.49	0.45	0.42
	1.5	0.42	0.38	0.36	0.32
	1.0	0.32	0.29	0.28	0.24
Plastic (Illustration same as below) Louvers	4.0	0.50	0.47	0.44	0.41
	2.5	0.46	0.42	0.41	0.37
	1.5	0.40	0.36	0.36	0.32
	1.0	0.34	0.29	0.30	0.26
Steel (white) Louvers	4.0	0.37	0.34	0.32	0.31
	2.5	0.34	0.32	0.30	0.28
	1.5	0.30	0.27	0.27	0.24
	1.0	0.26	0.23	0.23	0.20

The lumen method formula gives average footcandles over the entire area. The resulting illumination will be fairly uniform, but will show intensities in the center of the area slightly higher than the computed average, also intensities that are lower than the computed average near the wall areas.

Coefficient of utilization data are given for three types of luminous ceiling lighting in the accompanying tables. These data are for use with the lumen method formula. Some of the manufacturers of luminous ceiling lighting equipment use a different method of computation, however, in which Room Index is calculated by a different formula, and cavity proportions and characteristics are taken into account. When the equipment of these manufacturers is considered, it is suggested that their methods of calculation be followed.

Another factor worth keeping in mind is that when "average maintained footcandles" are estimated for an area, using the lumen formula, no allowance is made for "interference" absorption. Assume an office, or a school classroom, for example. The lumen formula does not take into account the furniture that will be placed in the area, neither its density (number of pieces and their size), nor its color and reflection factor. Also, no allowance is made for the number of persons who will occupy the room, and the light absorption value of the clothing they will wear.

The need for complete accuracy in making lighting intensity calculations, however, is questioned by some lighting engineers. Computations take time, and therefore cost money. Also, there are so many variables to be considered in making design calculations, that there is room for error on many factors. Assumptions usually have to be made on most of these variables. Footcandle design objectives are usually only a small percentage (2% to 5%, for example) of illumination levels found in nature. Therefore, a 10% deviation of a value that is, in the first place, only 2% of a possible optimum design level preference, becomes academic in its value. Therefore, even a simple rule of thumb procedure which will provide an estimated value within 10% to 15% of values which may be measured on the job after completition may in many cases be entirely adequate for the use to which the information will be put.

SUPPLEMENTARY LIGHTING

SUPPLEMENTARY lighting is used principally as an economic solution for providing a high intensity of quality lighting over a relatively small area where the desired intensity level cannot be justified throughout the entire area in the form of general illumination. It is also used to provide directional control and three-dimensional highlights and shadows which are desirable for many seeing tasks and permits the elimination of shadows from individuals which might result from general overhead lighting.

There are two basic types of lighting devices and equipment available for supplementary lighting. One is the point source type, and the other the line source type. There are a variety of designs available in each type. Two methods of calculations are used to predetermine footcandle intensity results which may be expected. Point-by-point calculations are used for the individual unit point sources having symmetrical distribution, and the lumens-per-foot method is used for calculations for continuous line reflector units. Supplementary lighting units may further be classified as directional (concentrated distribution), diffuse (spread distribution), and special purpose (luminous panels, cireline lamps, etc.). Units are made both for portable and for fixed, or fixed-adjustable use.

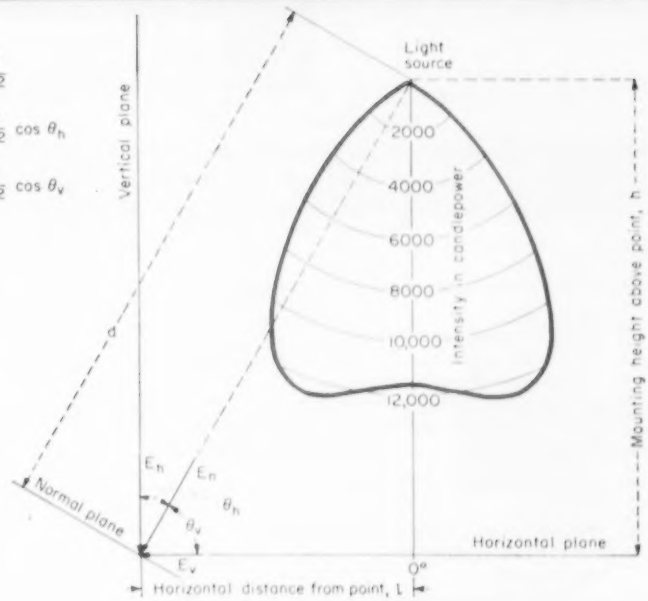
Current practice is to provide up to approximately 100 footcandles of general illumination throughout an area, and to provide higher intensities when required, ranging up to 500 footcandles, by means of supplementary lighting units. Such units have many applications, in industry, stores, offices, banks, public buildings, and in the home. All such units should be adequately shielded and properly mounted so that no glare exists, and intensities under units should not exceed five times the general illumination level, as a general rule.

POINT-BY-POINT CALCULATIONS

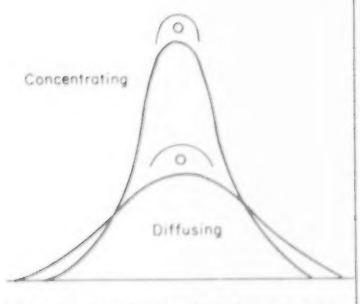
$$E_n = \frac{I}{d^2}$$

$$E_h = \frac{I}{d^2} \cos \theta_h$$

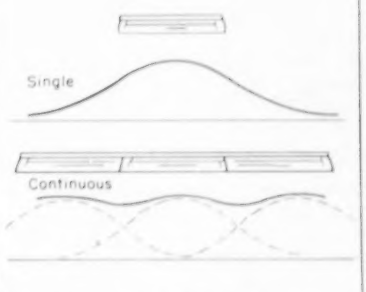
$$E_v = \frac{I}{d^2} \cos \theta_v$$



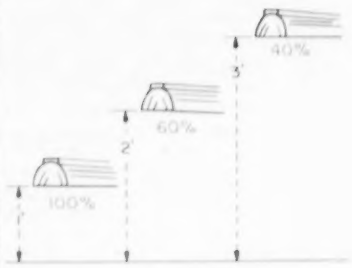
FACTORS AFFECTING LIGHT DISTRIBUTION AND LIGHTING INTENSITIES



A Concentrating reflectors provide more light at greater distance, but over smaller area.



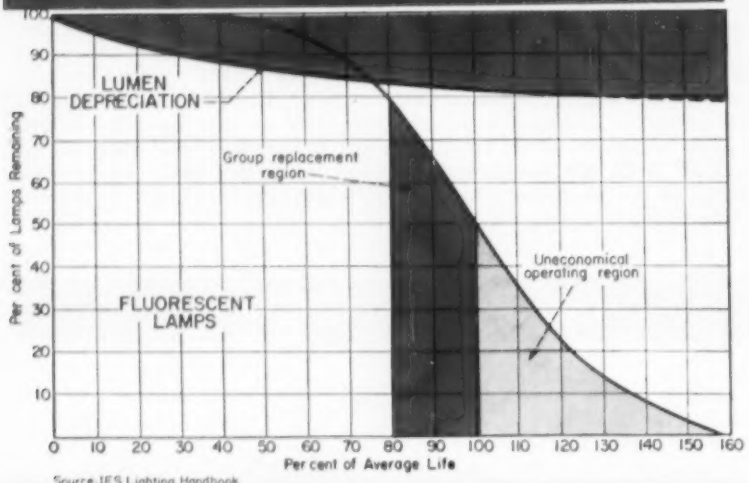
B Continuous row reflectors provide uniform intensity, overcome spotty effect of single units.



C Close mounting of units to work area provides more light on the seeing tasks.

LIGHTING ECONOMICS

LIGHT DECREASES WITH AGE OF LAMPS



Source IES Lighting Handbook

BASIC FACTORS FOR PREPARING A LIGHTING SYSTEM COST ANALYSIS

Lighting Systems	System No. 1
BASIC DATA	
1. Rated initial lamp lumens per luminaire	
2. Lamp life	
3. Average watts per lamp	
4. Watts per luminaire (includes ballast watts)	
5. Coefficient of utilization	
6. Maintenance factor	
7. Effective maintained lumens per luminaire (1 x 5 x 6)	
8. Relative number of luminaires needed for equal maintained footcandles	
INITIAL COSTS	
9. Net cost of one luminaire (estimated)	
10. Installation and distribution system cost per luminaire (estimated)	
11. Net initial lamp cost per luminaire (estimated)	
12. Total initial cost per luminaire (9 + 10 + 11)	
13. Annual owning cost per luminaire (15% of 9 + 10)	
14. Relative initial cost for equal maintained footcandles	
ANNUAL OPERATING COSTS	
15. Burning hours per year	
16. Annual energy cost (at estimated ¢/kwhr)	
17. Number of lamps replaced per year	
18. Lamp cost (17 x net price per lamp)	
19. Labor cost for lamp replacements	
20. Cost of cleaning twice per year	
21. Total annual operating cost per luminaire	
22. Relative annual operating cost for equal maintained footcandles.	
TOTAL ANNUAL COST	
23. Total annual cost per luminaire (13 + 21)	
24. Relative total annual cost for equal maintained footcandles	
25. VISUAL COMFORT INDEX, or GLARE FACTOR	

Source: "Fundamentals of Lighting Cost Analysis", by A. C. Barr and C. L. Amick. *Illuminating Engineering*, Sept. 1951.

MOST lighting customers use cost as a basis for appraisal of a lighting system. Unfortunately, so do many lighting salesmen and lighting engineers. And it is usually first cost only, for the lamps and luminaires, that is then considered. Operating and maintenance costs get secondary consideration, are ignored, or forgotten. And seldom is value, as contrasted with cost, given the consideration that it really deserves.

Considerable progress has been made in recent years, however, in developing procedures which make it relatively simple to make a lighting cost analysis. When such analyses are made for two or more lighting systems, the systems can then be compared on an equal basis using certain factors as a common denominator. One such procedure is outlined in the chart shown on this page, titled "Basic Factors for Preparing a Lighting System Cost Analysis". This procedure gives not only the actual annual cost in dollars, but provides a basis for obtaining relative total annual cost for equal maintained footcandles for direct cost comparison with other systems.

It is difficult, of course, to appraise lighting quality in dollars. Yet lighting quality, which in a sense is a measure of seeing comfort, is a major factor in the appraisal of a lighting system. Item 25 in the cost analysis table is the VCI value, or glare factor, which offers a basis for lighting quality comparison. Consideration should also be given to decorative qualities and aesthetic values inherent in the lighting, which are not included in the table.

Lighting economics embrace a wide range of factors. Some of the more important factors are listed below, and discussed briefly. The alert lighting engineer will add many more to the list.

Light sources—Efficiency, or lumens per watt, rated lamp life, size of lamp measured in total lumens, and burnouts per billion lumen-hours are all important economic considerations. It is usually more economical to use the lamp with the greatest lumen output possible, consistent with maintain-

ing uniform illumination throughout the area, than to use a larger number of lamps, each having a lower lumen output. Lamp burnouts are costly for labor used for replacement, therefore lamp life is important.

Luminaires—Total lumen output per luminaire should be as high as practical for proper light distribution. Overall efficiency is naturally important. And a factor seldom used, but of major importance from an economic standpoint, is lumens per dollar of initial cost for the luminaire.

Accessories—All ballasts should be of the high power factor type for minimum cost in wiring. Ballast efficiency, measured in lumens per watt based on total watts input, is important. And total weight of ballasts should be kept at a minimum, as provision has to be made to support this weight.

Maintenance — Luminaires and lighting equipment should be readily accessible and easily maintained, so they can be cleaned and relamped in the shortest time possible.

Heat—Total heat generated by the lighting system should be kept to a minimum. For air conditioned areas the heat has to be dissipated through increased capacity of the air conditioning system. The table "Lighting Systems Create Heat" gives Btu's per hour per footcandle which may be expected from various types of lighting systems. Also, on fluorescent lighting systems, it is important that fluorescent lamps operate in an ambient temperature of approximately 70 to 100 degrees, as light output decreases in temperatures above and below these values.

High voltage operation—High frequency lighting systems have also used high voltage (up to 300 volts to ground) for branch circuit distribution of energy, which offers wiring economies. Many 60 cycle lighting installations are also being made today at 240 to 277-volt branch circuit voltage, with comparable wiring economies.

Light colors and finishes—High reflection factors for ceilings, sidewalks, floors and furniture or machinery aids lighting efficiency. Use of light colors, and surfaces having high reflectance values, should be made wherever possible and practical, as this will help to reduce the overall cost of the lighting.

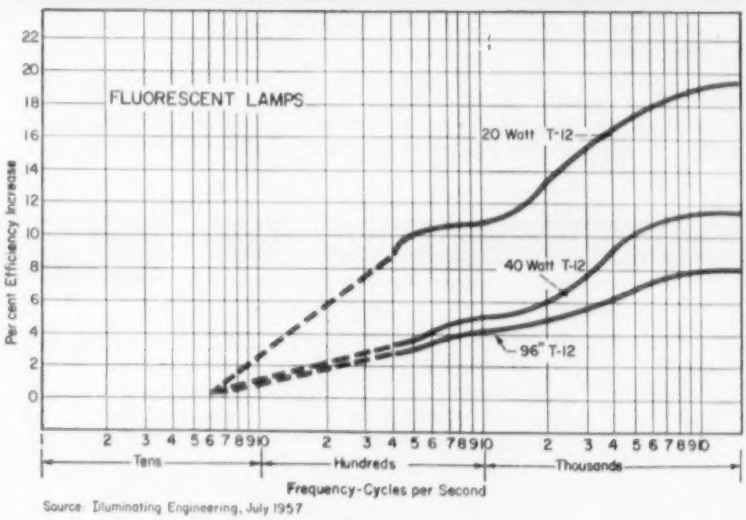
LIGHTING SYSTEMS CREATE HEAT

Luminaire Type	Heat Generated* Ceiling Height	
	12 ft up	Less than 12 ft
D	.25	.20
SD	.30	.25
G	.35	.27
SI	.52	.39
I	.53	.40

*Btus per hour per footcandle per square foot of floor area, based on medium size rooms of 500 to 2500 square feet, with 75% ceiling and 50% wall reflectances, using fluorescent lamps. For rooms larger than 2500 sq ft, decrease 10%. For small rooms less than 500 sq ft, increase by 20%. Data also apply for mercury vapor lighting. For incandescent lighting, values should be doubled.

Source: American Society of Heating and Air-Conditioning Engineers.

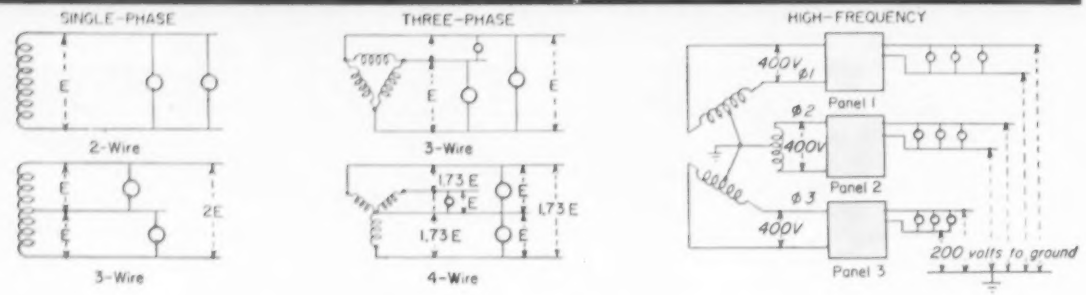
HIGHER FREQUENCIES INCREASE LIGHT OUTPUT



Source: Illuminating Engineering, July 1957

With built-in types of lighting, and especially with louvered and luminous ceilings, the lighting equipment replaces construction materials. For a true comparison of costs, the differences in construction costs should be applied to the lighting installation costs.

TYPICAL ELECTRICAL DISTRIBUTION SYSTEMS FOR LIGHTING



APPLIED LIGHTING

WIRING FOR LIGHTING

A CAREFULLY planned lighting system deserves a well planned wiring system. The lighting plan cannot be considered complete until the wiring system and branch circuit controls have been carefully studied and made a part of the plan.

The National Electrical Code, which is supplemented in many cities and localities by local codes and regulations, provides a guide to safety in wiring systems. The requirements set up by this Code and the various local codes are based on minimum requirements for safety. These requirements for safety do not necessarily meet the requirements of adequacy needed for maximum efficiency and trouble-free operation of the lighting system. In most instances, the most economical wiring job for the owner will far exceed the minimum requirements established by codes.

The wiring system should be designed so that full rated voltage exists at the sockets for incandescent lamps, or at the ballast and transformer lead connections for mercury vapor and fluorescent lamps, even when full load is applied. Any decrease in applied voltage results in a decrease in light output, and in a change in color quality of the light in the case of incandescent lamps. Only when full voltage is supplied can the owner get the full amount of light he pays for in energy consumed by the lighting system.

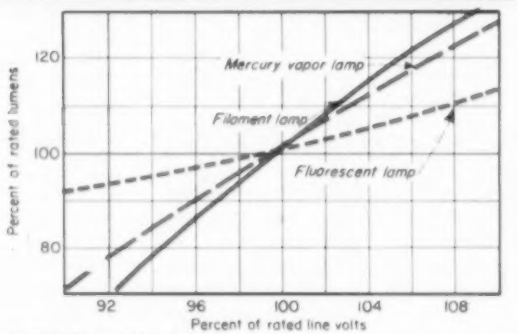
The almost universal electrical distribution voltage made available for lighting systems by the electric utility companies is the three-phase four-wire 120/208-volt 60 cycle system. Its availability and use is so general that most lighting engineers consider it as standard. Thus many fail to investigate the possibility of availability of other system voltages, or the economies which could result if other voltages were used. One distribution system which is being made available by many power companies where total electrical load will justify it is the 480/277-volt three-phase four-wire 60 cycle system. The 277-volt single-phase-to-neutral voltage of this system is ideally suited to fluorescent lamp operation, and provides real economies in wiring. Typical electrical distribution systems in general use today for lighting systems are illustrated by the five wiring diagrams at the top of this page. Lighting system voltages in general use are

LIGHTING SYSTEM VOLTAGES

60 Cycle		High Frequency
Incandescent Filament Lamps	Electric Discharge Lamps	Fluorescent Lamps
28-32	110-125	400*
110-125	220-240	600*
220-240	240-280	

*Phase-to-phase voltage, with grounded neutral to provide less than 300 volts to ground. (NEC)

ADEQUATE WIRING INCREASES LIGHT OUTPUT



Source: Westinghouse Lighting Handbook

shown in the table on opposite page.

A relatively new development in electrical distributon systems is high frequency power for the operation of fluorescent lighting systems. Installations made to date consist of frequency-voltage converters which operate from standard 60 cycle power systems. Three different systems, each with its own frequency and voltage characteristics, have been used. One system uses a magnetic frequency multiplier (non-rotating—no moving parts) and provides 360 cycles at 600 volts. Another uses a rotary converter and provides 400 cycles at 600 volts, with split phase windings and 300 volts to ground. The third system uses a rotary converter and provides 840 cycles at 400 or 600 volts, with split phase windings and 200 or 300 volts to ground. Wiring diagram for the 840-cycle 400-volt system is shown in the illustration at top of the page opposite.

In many industrial plants, research laboratories and similar areas there are requirements for high frequency electrical power other than for lighting. In these cases particularly, when new lighting is being considered, studies should be made to determine how the high frequency power and lighting requirements might be combined, and economic analyses made. Experiences with high frequency lighting to date would seem to indicate that it can be justified in large areas where high lumen output per luminaire can be used, and where there are economies in eliminating weight through the elimination of heavy ballasts required for operation of fluorescent lamps on 60 cycle power.

On relighting jobs, where a wiring system already exists, preliminary checks are helpful in determining whether the existing wiring is adequate for the proposed new lighting system. By determining the watts per square foot wiring capacity of existing branch circuits through survey, a quick check can then be made to determine the lighting intensity which will result from different types of luminaires, by using the chart above, titled "Lighting Intensity Determines Wiring Capacity."

Not too many years ago individual luminaires were equipped with switches so that each luminaire could be turned on and off independently from all the others.

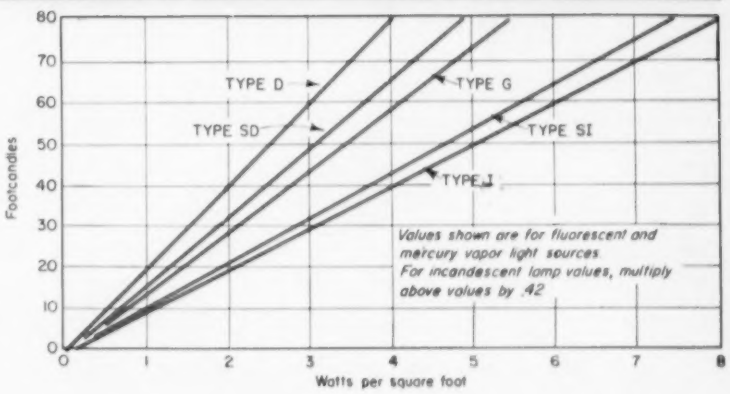
FLUORESCENT LAMP LUMENS PER WATT

After Adding Ballast Watts Loss

Type Ballast	Watts Loss*	Total Lamp Lumens	Lumens per Watt**
	110-125 Volt Range		
2-40T12	18	5000	51.0
2-40T17/IS	30	5000	45.4
2-90T17	31	10300	44.7
2-48T12	30	4600	43.4
2-96T12	34	10100	55.5
2-40T12/RS	14	5000	53.1
3-40T12/RS	13	7500	56.4
2-48T12/HO	20	6500	46.4
2-96T12/HO	36	14600	59.4
2-48PG17	41	12000	47.1
2-96PG17	80	26000	54.2
	240-280 Volt Range		
2-40T12	18	5000	51.0
2-90T17	31	10300	44.7
2-48T12	28	4600	44.2
2-96T12	34	10100	55.5
2-40T12/RS	12	5000	54.3
3-40T12/RS	18	7500	54.3
2-48T12/HO	30	6500	43.3
2-96T12/HO	20	14600	63.5
2-96PG17	75	26000	54.8
4-90T17	36	20600	52.1

*Per ballast, using high power factor types.
**Ratio of total lamp lumens generated to lamp wattage plus watts loss in ballasts. Lamp lumens based on cool white lamps.
Source: Based on data from Bulletin LS-101, G. E. Co., Nela Park, Cleveland.

LIGHTING INTENSITY DETERMINES WIRING CAPACITY

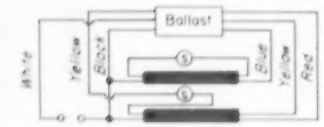


Luminaires were then generally of the one-lamp type. But the recent trend has been to control the lighting in an entire area, or on an entire floor or department, by means of remote-control magnetic switching, using relays and contactors, or by manual direct control of branch circuits using wall mounted branch circuit switches or circuit breakers, and by switching at the panelboard. In many types of lighting installations today, however, there is a growing need for flexibility in the lighting result. More than one lighting intensity may be desired from the same luminaire. Or there may be two or more types of lighting in the area (cove, recessed units, accent spots, etc.) and a need to control each type separately. Such flexibility can be obtained with dimmers, now available for fluorescent as well as incandescent lighting, or by multiple switching arrangements.

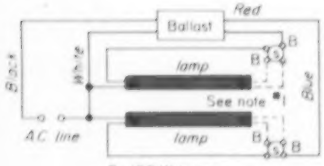
LIGHTING COMPONENTS

TYPICAL FLUORESCENT LAMP CIRCUITS

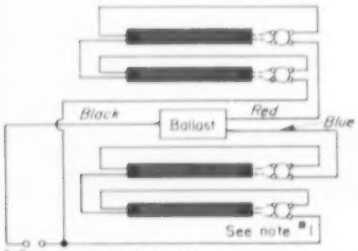
CIRCUITS USING STARTERS



2-40 W lamps
(medium bipin bases)

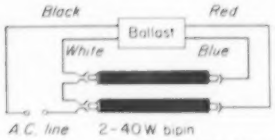


2-100 W lamps
(mogul bipin bases)



4-100 W lamps
(mogul bipin bases)

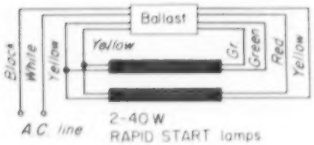
NO STARTERS REQUIRED



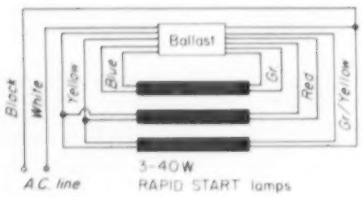
2-40 W bipin
INSTANT START lamps
(110-125 volts)

also

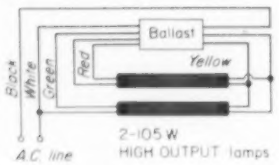
2-74 W 425 ma.
SLIMLINE lamps
(240-280 volts)



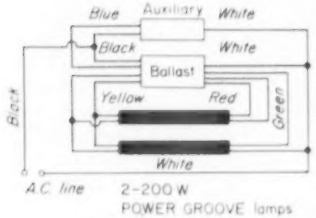
2-40 W
RAPID START lamps



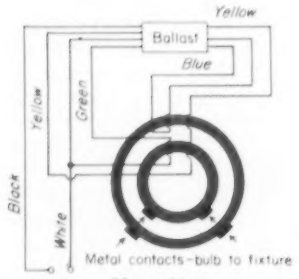
3-40 W
RAPID START lamps



2-105 W
HIGH OUTPUT lamps



2-200 W
POWER GROOVE lamps

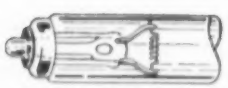


32 and 40 W
CIRCLINE lamps

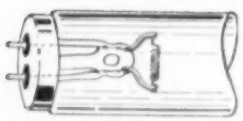
Note *1: B = Brass terminal on starter socket. When combination lampholder and starter socket assemblies are used, the dotted connections are already made internally.

Note *2: Circuit voltage (in all of the above diagrams, except that for connecting the 74 W 425 ma. slimline lamps) is 110-125 V.

FLUORESCENT LAMP CATHODES

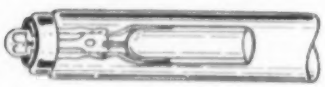


Instant start slimline type



Preheat type

HOT CATHODES



COLD CATHODES

SIMPLICITY of operation has featured incandescent (filament) lamps since their invention by Thomas A. Edison in 1879. All that is required is a lamp socket, connected to a simple two-wire branch circuit. If light control is wanted, the lamp is housed in a suitable reflector, diffuser, or refractor. Incandescent lamp sockets for standard type lamps used for general lighting are simple in design, and are candelabra base, medium screw base, mogul screw base or mogul bipost base types. Adequate mechanical strength, proper electrical characteristics, and ability to withstand the amount of heat generated by the lamps constitute the main requirements for these accessories.

Not so simple is the operation of fluorescent and mercury vapor lamps. These are forms of "electric discharge" light sources. These lamps require auxiliary devices for their operation, commonly referred to as "ballasts" for low voltage (preheat cathode, rapid start, etc.) lamps, and as "transformers" for high voltage (cold cathode), and mercury vapor lamps. Variations in diameter and length of lamps, and in types of electrodes used, also in type of electrical circuits em-

ployed and supply voltages for which designed, make it necessary to provide many sizes and types of ballasts, or transformers, each size and type being specifically designed to meet the particular requirements for each size, number and type of lamp. Fluorescent lamp ballasts are designed to operate one and two lamps generally, and three and four lamps in special circuits. Transformers are also designed to operate either one or two mercury vapor lamps. High voltage transformers are available with various secondary voltages, required to operate varying footages of cold cathode fluorescent lamps in series.

Light output and lamp life of fluorescent lamps depend on proper operating characteristics in the ballasts. High power factor type ballasts should be used for all general lighting systems. In interiors where quietness is essential, such as library reading rooms, art museums, school study rooms, etc., ballasts having low sound ratings should be used. When luminaire weight, or luminaire dimensions are a problem, consideration may be given to high frequency operation of the lighting system, in order to take advantage of the reduction in weight of the auxiliaries.

High power factor ballasts offer distinct advantages over low power factor types, and should be used for all general lighting applications. Some advantages are: 1) line current is kept normal and less circuit capacity is required; 2) additional lamps may be installed on many existing circuits; 3) voltage conditions are improved; and 4) the load on generating equipment is reduced.

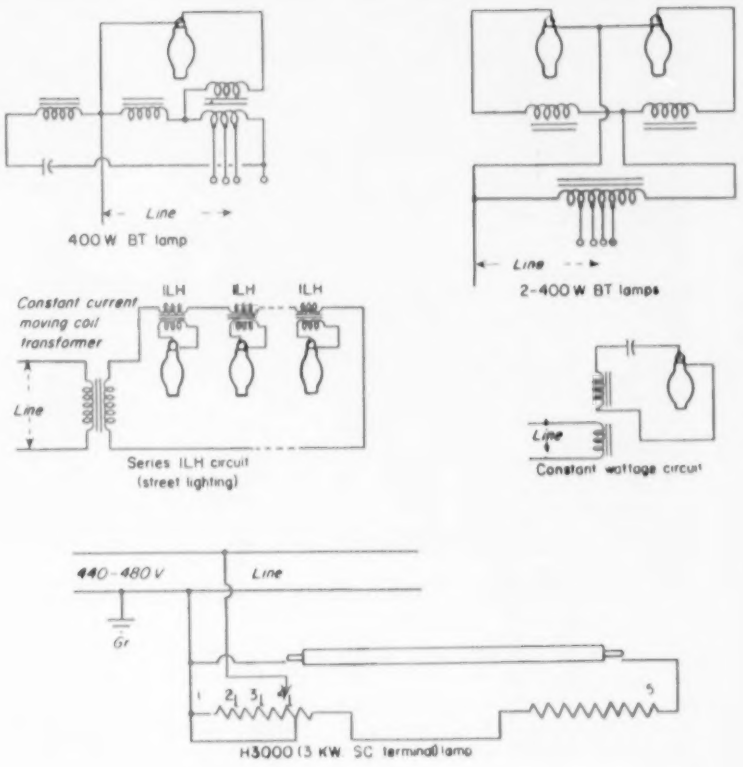
Pertinent technical data on some of the more popular types of ballasts, for quick and easy reference, are given in the accompanying table, "Typical Fluorescent Lamp Ballasts for General Lighting".

When direct current power only is available, and it is desired to use fluorescent lamps, this is possible if proper series resistance is used in connection with a suitable inductance coil and starting switch.

Wiring diagrams for some of the more popular types of ballasts and mercury vapor lamp transformers are given in the accompanying illustrations.

Fluorescent lamps can be operated at frequencies other than 60 cycles, with increases in light output as frequencies increase. When this is done, ballasts are reduced in size, and it is possible to substitute small choke coils and capacitors for the heavy ballasts required for normal 60 cycle operation.

TYPICAL MERCURY VAPOR LAMP CIRCUITS



Fluorescent lamps which employ preheat-type cathodes require starter switches for their operation. These switches are used to first preheat the cathodes, and then to quickly open the circuit to produce an inductive kick which starts the lamp. Cold cathode type lamps, on the other hand, use high voltage for starting the lamps, as do instant-start and slimline fluorescent lamps. For the first few years after fluorescent lamps were introduced, all fluorescent lamps, except cold cathode and instant-start types, were of the preheat-type, requiring the use of starter switches. Thus nearly all fluorescent lamp installations which were made from 1938 to 1945, when slimline fluorescent lamps were announced, employed starter switches.

After the introduction of slimline fluorescent lamps, and later the rapid start and high output lamps, and recently the very high output and power groove type lamps, the trend has been to fluorescent lighting systems which do not require starter switches to start the lamps. Only a small percentage of the installations being made today make use of the preheat-type lamps, requiring starter switches.

Because the various types of fluorescent lamps now available each require special starting and operating electrical characteristics, and because many of these different type lamps are the same physical size, it has been necessary to develop and use different types of lampholders, first to meet the varying circuit requirements, and second to prevent the interchangeability of different type lamps on the same ballast circuits. Lampholders are currently available with bases as follows: miniature bipin, medium bipin, mogul bipin, recessed double contact, single pin, 4-pin, and oval small 4-pin.

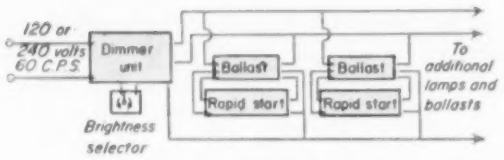
Dimmer equipment has long been available for incandescent lamps, and used on many types of

TYPICAL FLUORESCENT LAMP BALLASTS FOR GENERAL LIGHTING

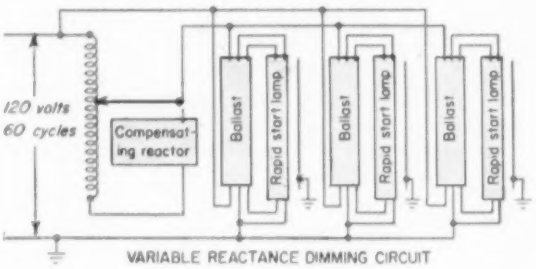
Type Lamps	Watts per Lamp	Lamps per Ballast	Weight (lbs)	Line Current (amps)	Watts Loss	Watts Input
For 60 Cycle, 110-125 Volt Circuits:						
F40T12	40	2	4	0.85	18	98
F40T17	40	2	9¾	0.95	30	110
F48T12	38	2	9¾	0.95	30	106
F96T12	74	2	13¾	1.60	34	182
F40T12/RS	40	2	4	0.85	14	94
F40T12/RS	40	3	9¾	1.30	13	133
F48T12/HO	60	2	10	1.20	20	140
F100T12/HO	100	2	17	2.20	35	235
F96T12/HO	105	2	15½	2.30	54	264
F48PG17	107	2	20	2.10	16	230
F96PG17	200	2	15	4.30	80	480
For 60 Cycle, 240-280 Volt Circuits:						
F40T12	40	2	5¼	0.37	18	98
F48T12	38	2	9¾	0.43	28	104
F96T12	74	2	13¾	0.70	34	182
F40T12/RS	40	2	4	0.39	12	92
F40T12/RS	40	3	11	0.55	18	138
F48T12/HO	60	2	10	0.56	30	150
F96T12/HO	107	2	14	0.88	16	230
F96PG17	200	2	14	1.90	75	475

Source: Based on Data in Bulletin LS-101, G. E. Co., Nela Park, Cleveland.

FLUORESCENT LAMP DIMMER CIRCUITS



ELECTRONIC DIMMING CIRCUIT



VARIABLE REACTANCE DIMMING CIRCUIT

installations. Incandescent lamps are easily dimmed, merely by applying a variable voltage at the socket. The range of brightness of the lamps can be controlled from full brightness to complete blackout.

Fluorescent lamps are not so easily dimmed. But in the last few years two systems for controlling the brightness of fluorescent lamps have been developed, and dimmer equipment made available. One makes use of an electronic dimming circuit, and the other uses a variable reactance dimming circuit. These two circuits are illustrated in the accompanying wiring diagrams under the title "Fluorescent Lamp Dimmer Circuits".

The electronic fluorescent dimmer provides a smooth dimming range from full brightness of the lamps down to about 1% of maximum light output. Basically, the circuit consists of four parts: 1) 40-watt rapid-start fluorescent lamps; 2) dimming ballasts; 3) the dimmer unit; and 4) a brightness selector. Lamp brightness control is accomplished by controlling the interval of current flow during each half cycle of the 60-cycle voltage. This current control unit uses two thyratron tubes connected back to back so that the pair of tubes will conduct current for both polarities of the ac voltage. Dimming is achieved by varying a small resistor which controls the phase angle of the grid voltage, and thus controls the current delivered to the ballast and the lamp. Either manual or automatic operation is possible. This dimmer will control any number of fluorescent lamps up to a total of 32 lamps.

The variable reactance fluorescent dimmer provides a simple, low cost method of controlling the brightness of fluorescent lamps. It permits dimming down to 2% of full brightness. It does not give the same degree of smoothness in dimming that can be obtained with the electronic dimmer, but does provide a very satisfactory means of adding flexibility to fluorescent lighting systems.

Dimmers for both incandescent and fluorescent lighting systems are being used to considerable extent on recent lighting installations. Simple units are now available for dimming small lamp loads, especially as found in the home. Also dimmers, or in some cases multiple switch control, are being used for display rooms, for small auditoriums, for special color lighting systems, and for decorative uses of light.

Light measuring instruments are not, strictly speaking, lighting components. But they are very closely related. Lighting engineers today need various information and data to enable them to design and lay out the best possible solution for the many and varied lighting problems encountered. Several instruments have been developed which make it possible to get such information, direct from completed lighting jobs. The principal portable type instruments available for field use are: light meters (illuminometers) in several models with scales calibrated for specific light value ranges; visibility meters, for determining lighting intensities needed for specific seeing tasks; voltmeters, for checking voltages delivered to the lamps; brightness meters, for determining brightnesses and aiding in the improvement of lighting quality; and color temperature meters, for determining the spectral characteristics of light delivered to a work surface.

Today's well-informed lighting designer should maintain an up-to-date library of lighting literature. This library should include a good lighting handbook, complete catalogs of several lighting equipment manufacturers covering all types of lighting equipment, catalogs and listings of electric lamps, ballasts, transformers, dimmers, and other related lighting accessories, instruments and devices.

NEW HEADQUARTERS of Connecticut General Life has main building, penetrated by four garden courts, built around six mechanical cores. North wing houses administrative offices and lobby. South wing is 800-seat cafeteria overhanging a reflecting pool. Stack at right rises from underground boiler room vault covered by 4 ft of earth. Electric service is underground.

ELECTRICAL SYSTEMS

for New CGI Office Building

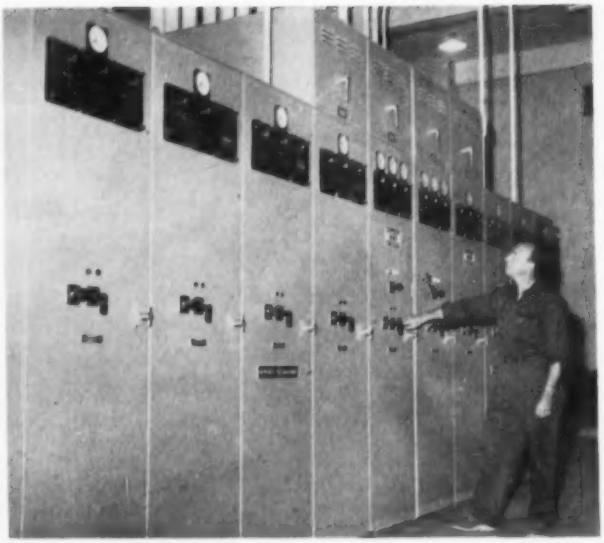
Suburban Hartford, Conn. headquarters of Connecticut General Life Insurance Co., cited as outstanding triumph of modern architecture, is served by duplicate primaries, radial selective high voltage distribution, 227/480-volt power and fluorescent light.

By W. T. Stuart

Architects—*Skidmore, Owens & Merrill*
Engineers—*Syska & Hennessey*
General Contractor—*Turner Construction Co.*
Electrical Contractors—*Fischbach & Moore, Inc.*

FOUR YEARS in planning and building, the new headquarters of the Connecticut General Life Insurance Co. in suburban Bloomfield, five miles northwest of the center of Hartford, Conn., has aroused international interest as an outstanding example of modern American architecture and the effective application of modern construction materials and methods. Surfaced with plate glass, stainless steel and aluminum, the structure is located on a 275-acre tract of rolling land, 80 acres of which is landscaped. The main building has three levels, penetrated by four garden courts. A five-level wing houses some administrative offices and the public lobby. Another one-story wing, housing the cafeteria, overhangs a reflecting pool.

OUTDOOR MASTER SUBSTATION has duplicate 5000-kva transformers stepping utility 22.9 kv to 4.16 kv for distribution underground to building master switchgear.



MASTER SWITCHGEAR distributes energy from two incoming 4.16-kv services to seven substations. Panel at left switches feeder from emergency generator to main buses.

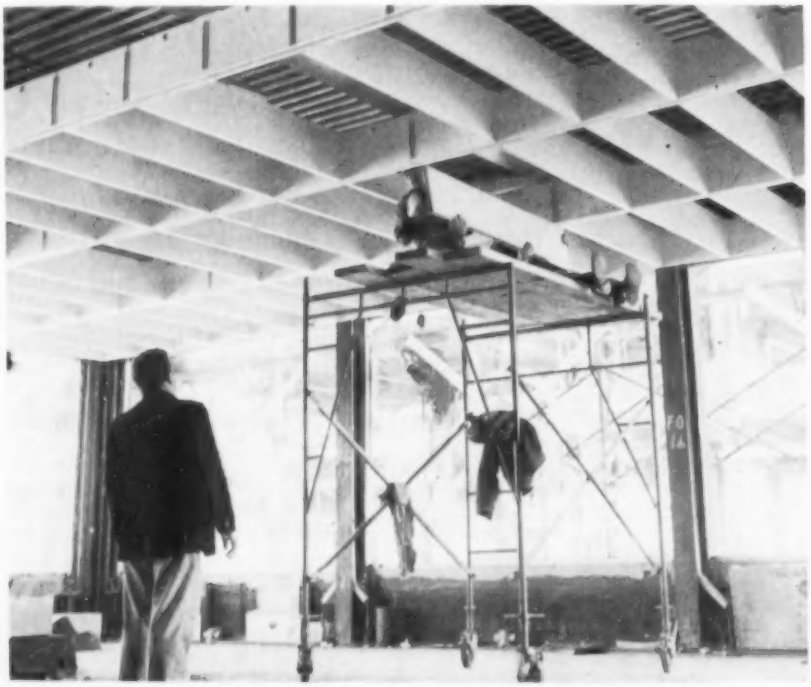
Underground Supply

Power is supplied by the Hartford Electric Light Co. by means of two independent 22.9 kv underground feeders. Each feeder is sized to carry the full load of the building independently of the other.

Utility service is brought to a master substation with two 5000-kva, 22.9/4.16-kv transformers. Each transformer is capable of handling 75% of the connected load of the building, and provisions are made for fan cooling to increase output to 6250 kva from each transformer. A tie breaker is provided between the transformer secondaries.

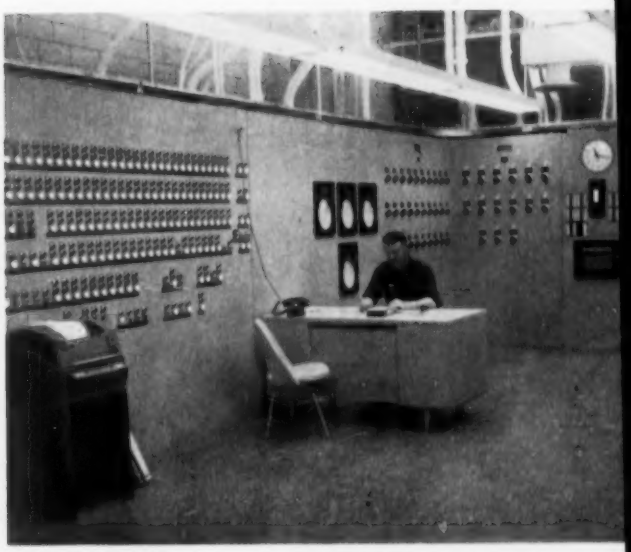
Two sets of three 500 MCM feeders per service (four in all), carry 4.16-kv power to the master switchgear in the building. Each set of feeders is sized to carry the demand

CLOSEUP of temperature reading panel in control center. Instrument gives temperature reading of 108 areas.



INSTALLATION of open baffle ceiling. Acoustical baffles are on 2-ft centers between wiring channels on 6-ft centers. Open 6-ft lamp, operated at low brightness, is centered in each opening.

EMERGENCY GENERATOR in boiler room provides 750 kva at 4.16 kv to provide power to essential loads in the event of a general power failure.



ENGINEER'S OFFICE provides central surveillance and control of building heating, cooling and ventilating equipment. Alarm systems are also centralized in this area.

load of the entire building. In addition to the service feeders, four spare 4-in. conduits are extended from the master substation to the building. Total connected load of the building is 6600 kva and demand is 5000 kva based upon a 75% demand factor.

4.16-Kv Distribution

Electrical distribution from the master switchgear is carried at 4160 volts to substations located in seven rooms in the basement. The system is primary selective radial with secondary ties and was selected for maximum reliability and safety.

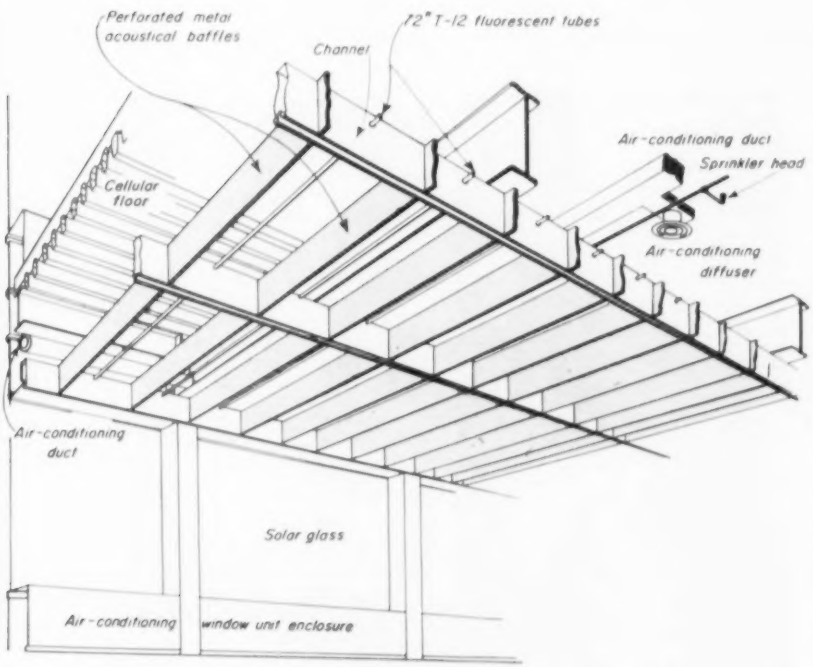
Each substation can be connected to either of the two primary services. Through secondary ties, the secondary load of one substation can be carried by another substation. Transformers and secondary ties are sized for 80% of connected load for emergency standby at permissible overloads on the transformers.

For example, substation 6 and substation 3 have transformers rated at 1000 kva each. The connected loads are 914 kva and 660 kva respectively or a total of 1574 kva; at 80%, 1260 kva. At overload rating, the transformers may be pushed to 125% capacity or 1250 kva. Thus either substation has emergency capacity to carry the load of both. Main breakers and tie breakers are mechanically interlocked for system protection.

Substation secondary voltage is 277/480 which is the utilization voltage provided for fluorescent lighting and motors ¾ hp and larger. Other utilization at 120/208 volts is provided from the 480-volt system through air cooled transformers.

Utilization voltages for general building loads are as follows:

Fluorescent lighting	277/480
Motors, ¾ hp and larger	277/480
Incandescent lighting	120/208
Kitchen equipment	120/208
Motors, ½ hp and smaller	120/208



DETAIL of open baffle ceiling combining lighting and acoustical treatment. Note cellular floor above which doubles as electrical raceway. Components are designed to 6-ft modules. Lower edges take partitions.

TYPICAL LIGHTING applications, all on 6-ft module, include: (right) Open baffle ceiling with low brightness lamps on 2-ft centers; (center) Luminous ceiling with corrugated plastic diffusers; (far right) Troffers, 2 ft by 4 ft, in conventional metal pan ceilings.

Emergency Power

A diesel engine-generator plant provides 750 kva at 4.16 kv for emergency power and light. The plant is manually started from battery power. Its main breaker is interlocked mechanically with the primary circuit breakers to avoid feeding into the master substation. The plant is capable of carrying all emergency loads such as a well pump, a fire pump, heating plant load and emergency lighting throughout the building. The prime mover is a V12 diesel engine of the type used in diesel electric locomotives and operates on fuel oil.

Central cores (of which there are six in the main building and one in the wing), house the mechanical services of the building and provide for vertical distribution of electric power and other services. One of seven 1000-kva substation transformers serves each core through electrical closets located on each floor. The remaining two 1500-kva transformers serve the bulk of the mechanical equipment.

Each group of motors in a core area is served by a motor control center of which there are 19 in all. Control circuits for fans and other mechanical units are extended from the motor control centers to an operating control panel in the central control room.

Branch circuits for power, and telephone and signal services are carried in the cellular steel floor on two levels and underfloor ducts were required on the lower level. Headers in the cellular floor provide access to cells for each service on 6-ft centers.

Lighting

A wide variety of lighting systems are employed through the building. The principal system, applied to most of the general office area, is a special design conception of the architects and engineers and developed by Smithcraft Lighting for the building. Deep vertical acoustical baffles form a grid, 2 ft by 6 ft, in which is centered an open 6-ft T12 fluorescent lamp energized by a special ballast reducing the lamp current to 120 milliamperes for low brightness. The grid is open above and below, giving access to the ceiling and mechanical elements above, all of which is painted with a uniform high reflectance white finish. The deep baffles cut off direct view of

HEAVY PLATE glass doors open under slight pressure with hydraulic aids

the lamps at normal angles of vision.

In corridors, employee recreation areas and lounges, the cafeteria and auditorium, flush incandescent down lights are used extensively. An auditorium seating 500 has full theater equipment including stage switchboard, disappearing foots, flush stage pockets and borders.

Typical lighting intensities provided are:

(a) Baffle ceiling, 45 to 55 footcandles, depending on the size of the areas and rooms. Load is 2.83 watts per square feet. By changing ballasts from 120 ma to 200 ma lighting intensities can be increased to 60-70 footcandles.

(b) Troffer lighting, 45-55 footcandles at 2.78 watts per square foot.

(c) Auditorium, up to 30 footcandles of incandescent lighting on dimmer control.

(d) Cafeteria and lounge, 30 footcandles of incandescent lighting.

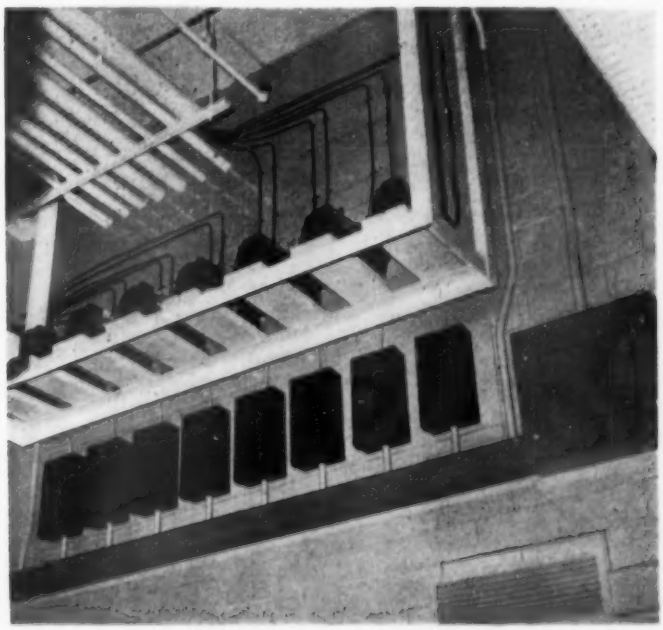
(e) Luminous ceiling in north wing, 45-55 footcandles using 200 ma ballasts.

Communications

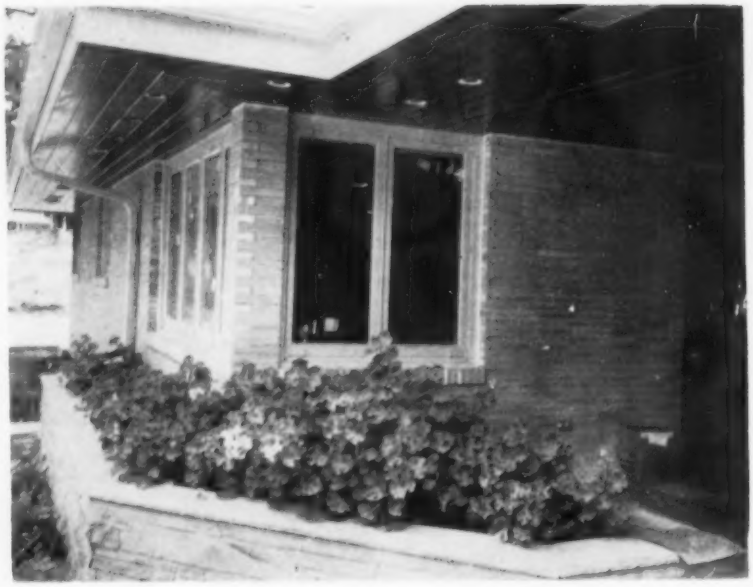
The telephone switchboard, with provisions for five operators, is connected with 30 trunk lines and equipped with a dial system for intercommunication among the more than 1000 telephone instruments.

Two dictating systems connect to a central transcribing department. Those who dictate large quantities of work use a dictating instrument, similar to a telephone, which is wired to recorders. The needs of some 500 employees who do only occasional dictating are taken care of by a system which automatically connects any telephone to a bank of recording machines controlled by a console in the stenographic department. Background music, announcements, paging and emergency signals are provided by a public address system. Electrical substations, the telephone switchboard room and the underground vault area are equipped with an automatic fire detection system.

A precision controlled clock system employs electronic high frequency signal transmitters connected to all 120/208-volt transformer secondaries. The individual clocks, connected to the 120-volt lines, are controlled by the superimposed signal.



which are powered by electrically operated and controlled hydraulic pumps.

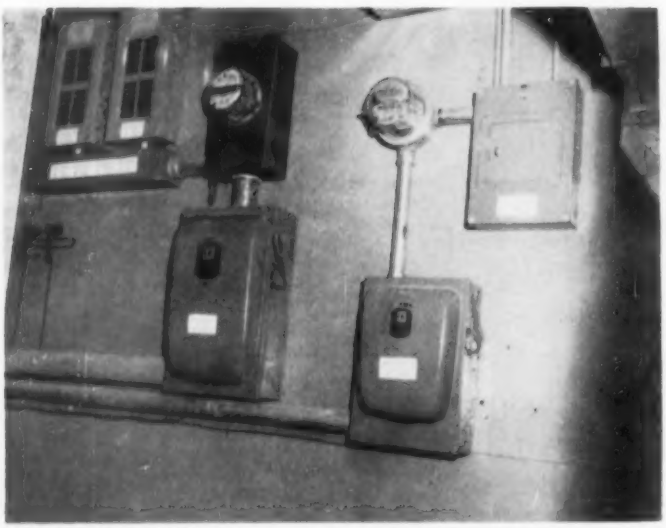


ROOF OVERHANG has 27 recessed fixtures, operated by three separate master control stations located at the front door, the garage door, and the master bedroom.

By W. J. Martens

10,000 WATTS OF RESIDENTIAL LIGHTING

installed in a new dwelling in Des Moines features a combination of recessed and surface fixtures, dimming on living room lights, and remote control switching.



SERVICE ENTRANCE equipment includes 200-amp, single phase, underground service for 10,000 watts of lighting, numerous appliances, and other general purpose outlets. Separate service of 100 amps is also brought in underground to provide for eight tons of air conditioning and two electronic dust filters.

BROWN & WESTON, electrical contractors of Des Moines, Iowa, are promoting top-quality residential wiring and lighting through newspaper advertising, a large fixture display room (largest in the State), and trained specialists in residential lighting and wiring application. With expert planning and performance, they are selling modern lighting and wiring installation to home builders in the area that goes far beyond minimum requirements and builds the electrical system into a major feature of the new home.

One of the projects recently planned, sold and installed by Brown & Weston involved the wiring and lighting of a ranch type home including over 10,000 watts of fixed lighting. They installed 185 recessed fixtures of various types and designs and 15 surface or suspended fixtures.

The living room has 35 recessed

PERIMETER LIGHTING installed in ceiling in living room provides general illumination throughout entire room and also gives good local lighting for furniture settings.

DECORATIVE EFFECTS will be produced in living room where the 35 recessed fixtures are controlled by 4000-watt motor-driven dimmer switch.

fixtures located around the perimeter of the room. They provide general lighting while giving good local lighting over furniture settings and eliminate the need for portable lamps. The 35 fixtures are controlled by three, nine-point, low voltage, master control units. And in order to furnish further control, they are operated by a 4000-watt motor driven dimmer that will raise and lower brightness to any degree desired.

The kitchen and utility rooms also feature perimeter lighting, employed to illuminate work areas such as counter tops, surface cooking units, dishwasher, and sink, while still providing overall lighting throughout both rooms.

Basement stairway and bedroom halls are lighted by means of 100-watt recessed fixtures, mounted 3 ft from the floor. These units come equipped with 30-degree lenses that direct the light downward.

Bath area vanities are lighted by 100-watt recessed fixtures with 30-degree photo lenses that project light into the mirror, rather than the user's eyes. In addition, three 250-watt sun lamps are installed in individual pull-down fixtures located in the small tiled area next to the bathroom, and are operated by a 0 to 60 minute time clock. All shower stalls are equipped with vaportight fixtures. Closet lights are small recessed units operated by ultra-sensitive magnetic sliding door switches. For decorative treatment and general illumination, surface type fixtures are used in bedrooms, bathrooms, the front entrance hall, and the dinette.

Exterior lighting incorporates 27 recessed fixtures located around the entire perimeter of the house, while flood lamps and six post lights brighten the entrance drive to complete the outdoor lighting. The lighting system was designed and engineered by Brown & Weston's lighting consultant, W. Siglin.

Remote Control Switching

The entire house is wired for remote control, low voltage switching including 86 remote control relays and seven 9-station master control panels. Master stations located at the front door, the garage door, and the master bedroom make it possible to provide a path of light through the center of the entire house, while at the same time turning on all outside fixtures including post lights.

Eight ventilating fans are in use throughout the new home and eight tons of air conditioning keep it comfortably cool during the summer months.

The service entrance includes a 200-amp underground service with 50 circuits to serve the 10,000 watts of lighting, the numerous electrical appliances, and general purpose outlets. To provide for the eight tons of air conditioning equipment, and the two electronic dust filters, a separate underground service of 100 amps was installed.

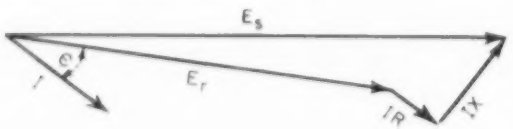
Easy-to-Use

VOLTAGE DROP CHARTS FOR ALUMINUM CONDUCTORS

New graphic method of determining aluminum wire voltage drop for specific circuit conditions. Projections on a single chart give percent-drop answers.

By G. H. Redden, *Insulated Cable Engineer*
Kaiser Aluminum & Chemical Sales, Inc., Chicago, Ill.

Fig. 1—Vector Diagram and Formulae



E_s = sending voltage, line-to-neutral in volts
E_r = receiver voltage, line-to-neutral in volts
I = load current in amperes
θ = load power factor
R = resistance of one wire to load in ohms
X = line-to-neutral reactance in ohms

The formula for E_s according to the above vector diagram for lagging power factor is:

$$E_s = E_r + IR \cos \theta + IX \sin \theta + jIX \cos\theta - jIR \sin \theta \quad (1)$$

For practical purposes, the quadrature components of the above equation may be eliminated. Hence, the equation reduces to:

$$E_s = E_r + I(R \cos \theta + X \sin \theta) \quad (2)$$

Equation (2) is the basis upon which the voltage drop charts are constructed. The error is a maximum for large conductors and heavy ampere loads over long distances at unity power factor. Assume for example, the case of three 1000 MCM aluminum conductors delivering a balanced 445-ampere, 3-phase load at unity power factor for a distance of 690 feet with conductors spaced at random in steel conduit, 440-volts, 60-cycle a-c. The percent drop using equation (1) is 3.17%; whereas, for equation (2) it is 3.05%. The difference is 0.12%. When the percent voltage drop is expected to be large and a high degree of accuracy is desired, the problem should be solved analytically.

VOLTAGE drop in feeders, subfeeders and branch circuits is an important consideration in the design and efficient operation of any electrical distribution system. Electrical engineers and contractors responsible for selection of conductor sizes consider a quick and accurate solution to voltage drop problems a "must" in their daily operations. The Aluminum Wire Voltage Drop Charts introduced here and presented on the following pages are offered as a means of simplifying voltage drop calculations. They were originally developed by Kaiser Aluminum & Chemical Sales, Inc., to assist company service engineers in making recommendations for aluminum building wire installations.

Biggest time-saving advantage is the direct-reading feature of the charts. The percent voltage drop may be read directly from the chart for a given ampere load, circuit length and system voltage. In the process of determining percent voltage drop, the correct conductor size is automatically revealed. Eliminated entirely is the need to first obtain ampere-feet according

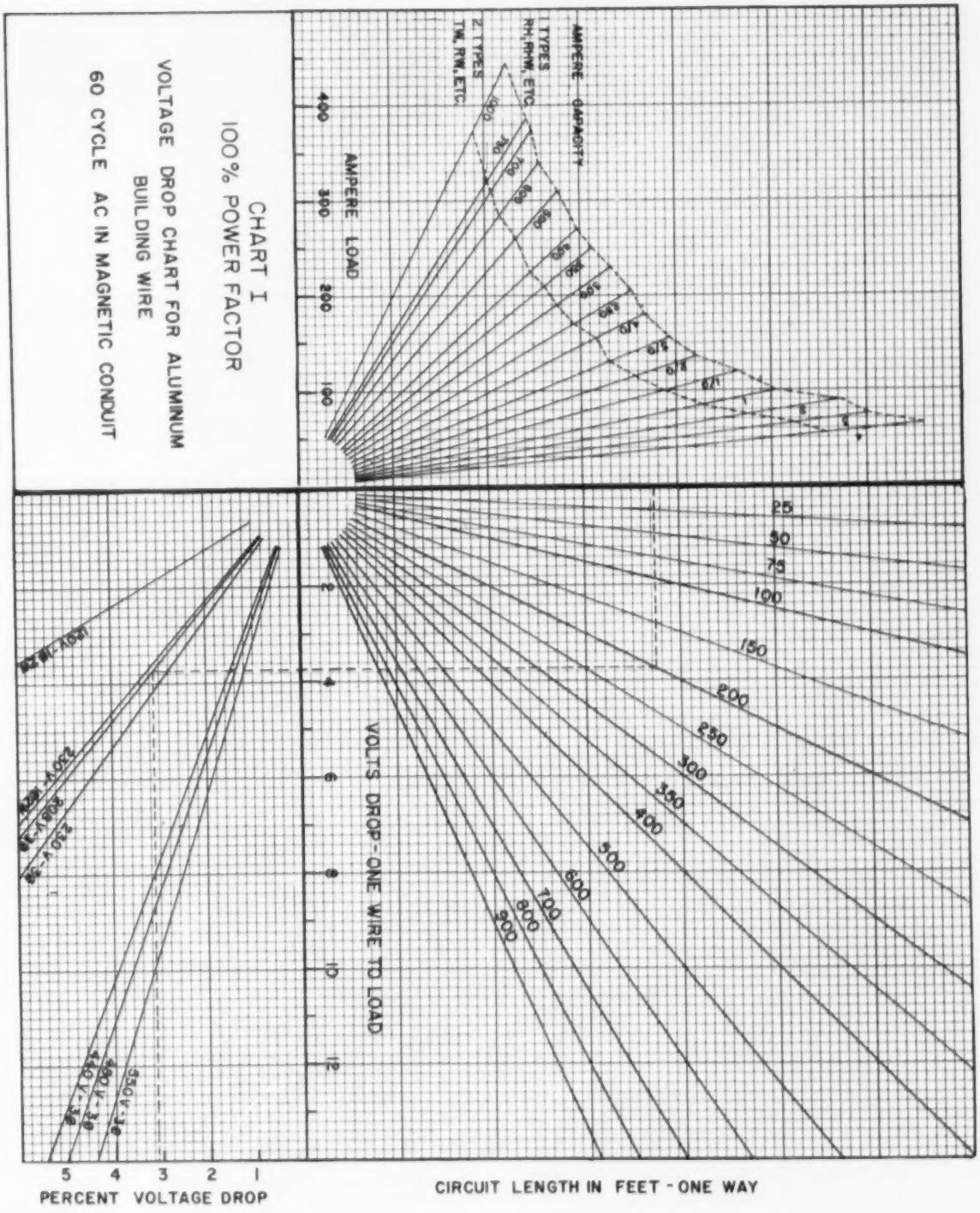


CHART I
100% POWER FACTOR
VOLTAGE DROP CHART FOR ALUMINUM
BUILDING WIRE
60 CYCLE AC IN MAGNETIC CONDUIT
AMPERE CAPACITY
AMPERE LOAD
1. TYPES RH, RHW, ETC.
2. TYPES TW, RW, ETC.
VOLTS DROP - ONE WIRE TO LOAD
PERCENT VOLTAGE DROP
CIRCUIT LENGTH IN FEET - ONE WAY

NOTES:

1. VOLTAGE DROP CALCULATED ON BASIS OF ALUMINUM AC RESISTANCE AT 75°C.

2. AMPERE RATINGS ARE BASED ON NOT MORE THAN THREE CONDUCTORS IN RACEWAY OR CABLE OR DIRECT BURIAL AND AMBIENT ROOM TEMPERATURE OF 30°C. IN ACCORDANCE WITH 1956 EDITION OF NEC.

3. FOR USE IN 3-WIRE, 1 PHASE CIRCUITS, ALUMINUM CONDUCTORS SIZES 2-4/0 MAY BE RATED AT 84% OF COPPER RATINGS.

to usual practice, or to make additional computations to convert volts drop to a percent value.

Standard single-phase and 3-phase voltages for power and lighting systems are included in the charts. For the sake of simplicity, other nominal voltages (such as 220-volt, 3-phase; and 240-volt, 3-phase) are not shown. However, simple linear interpolation between the voltage curves may be used with reasonable accuracy for such systems. (See example under heading, How to Use Charts.)

The following three charts are based on different power factors. Choice of the correct chart to use for voltage-drop determinations depends upon the power factor of the load to be served by the electrical system.

1. 100% Power Factor Chart—should be used for lighting and resistance heating loads.

2. 90% Power Factor Chart—may be used for combination power, lighting and resistance heating circuits.

3. 80% Power Factor Chart—may be used for power, or motor loads.

Chart Design

Basically, the charts were designed to facilitate voltage drop determination and eliminate the laborious calculations involved in an ac circuit problem. In their development, certain qualifications were made which have a negligible effect on their accuracy. For example, it is assumed that circuits are balanced. If considerable circuit unbalance exists, then it would be advisable to solve the problem analytically using more precise formulae. Capacitance of the circuit at the voltages involved (600 volts or lower) is usually negligible and is therefore omitted.

The formulae and vector diagram shown in Fig. 1 serve as the bases for the voltage drop charts.

The ac resistance of aluminum conductors is taken at 75° C in metallic conduit and corrected for stranding and skin effect. Reactance values are taken from an AIEE pamphlet "Electric Power Distribution for Industrial Plants" and are for magnetic conduit, random lay. Though magnetic pipe was assumed, the charts may be used when the conductors are installed in non-magnetic conduit or pipe. If the conduit is of non-magnetic type, the results will be on the conservative side.

For those accustomed to making their own calculations, Table I (*resistance* of aluminum cable) is included in this article.

Aluminum Ampere Rating

Although the charts were primarily designed to simplify voltage drop calculations, the ampere capacities of the aluminum conductors (Table Ia, 1956 NEC) are shown in the upper left corner of each chart. These will apply in those cases where short runs do not require voltage drop calculations. Therefore, each chart indicates the allowable current-carrying capacity of insulated aluminum conductors for both conditions of 60° C and 75° C maximum conductor temperature in a 30°C ambient for not more than three conductors in a raceway or cable. For more than three conductors, consult the notes to Tables 1, 1a, 2 and 2a of the 1956 edition of the National Electrical Code.

In the revised 1956 ratings for aluminum conductors, the NEC makes an exception for 3-wire, single-phase service and sub-service circuits. The allowable current-carrying capacity of RH, RH-RW, RHH and RHW aluminum conductors for this service shall be as follows:

AWG SIZE	CURRENT RATING
No. 2	100 Amps
No. 1	100 Amps
No. 1/0	125 Amps
No. 2/0	150 Amps
No. 3/0	170 Amps
No. 4/0	200 Amps

The above ratings agree with the 1953 NEC ratings, since the neutral in a single-phase, 3-wire circuit normally carries only the unbalanced current and therefore does not itself introduce sufficient heating to require de-rating. For example, a No. 2 AWG service entrance cable, such as SE Style U, or Type USE, with 75° C insulation may be used for a 100-Amp Main Service to a residence.

The 1953 NEC establishes the ampere ratings for aluminum conductors as 84% of the same size copper conductors. The 1956 NEC ratings have been established on the basis of 78% to 84% of the corresponding copper size capacity (see Tables 1a and 2a, Chapter 10, 1956 NEC).

How to Use Charts

To capitalize on the time-saving features of the voltage drop charts, five basic circuit factors must be known before the chart can be used. These are:

1. Load Power Factor—to select proper chart.

2. Load Amperes—to establish a starting point on the chart.

3. Circuit Length—in feet, one way.

4. Circuit Voltage—single-phase voltage, or phase-to-phase voltage for a 3-phase circuit.

5. Allowable Voltage Drop—set the limits for circuit voltage drop. Common practice establishes a maximum of 3% for power or heating loads and 2% for lighting loads.

Once these factors are known for a specific circuit or feeder, selection of a conductor size that will operate within the prescribed voltage drop limits becomes a simple matter.

To illustrate use of the charts, let's solve the following hypothetical problem.

Find the conductor size for a circuit serving a 75-hp, 208-volt, 3-phase motor located 200 ft from the distribution panel. Voltage drop is to be limited to about 3%.

List the circuit factors relevant to the voltage drop chart:

1. Load Power Factor—taken as 80% for this motor operating at full load.

2. Load Amperes—245 amps. Full load current of motor is 196 amps (Table 24, NEC). Conductors must carry minimum of 125% of motor full load current (Section 4312, NEC). 1.25 x 196 = 245.

3. Circuit Length—200 ft.

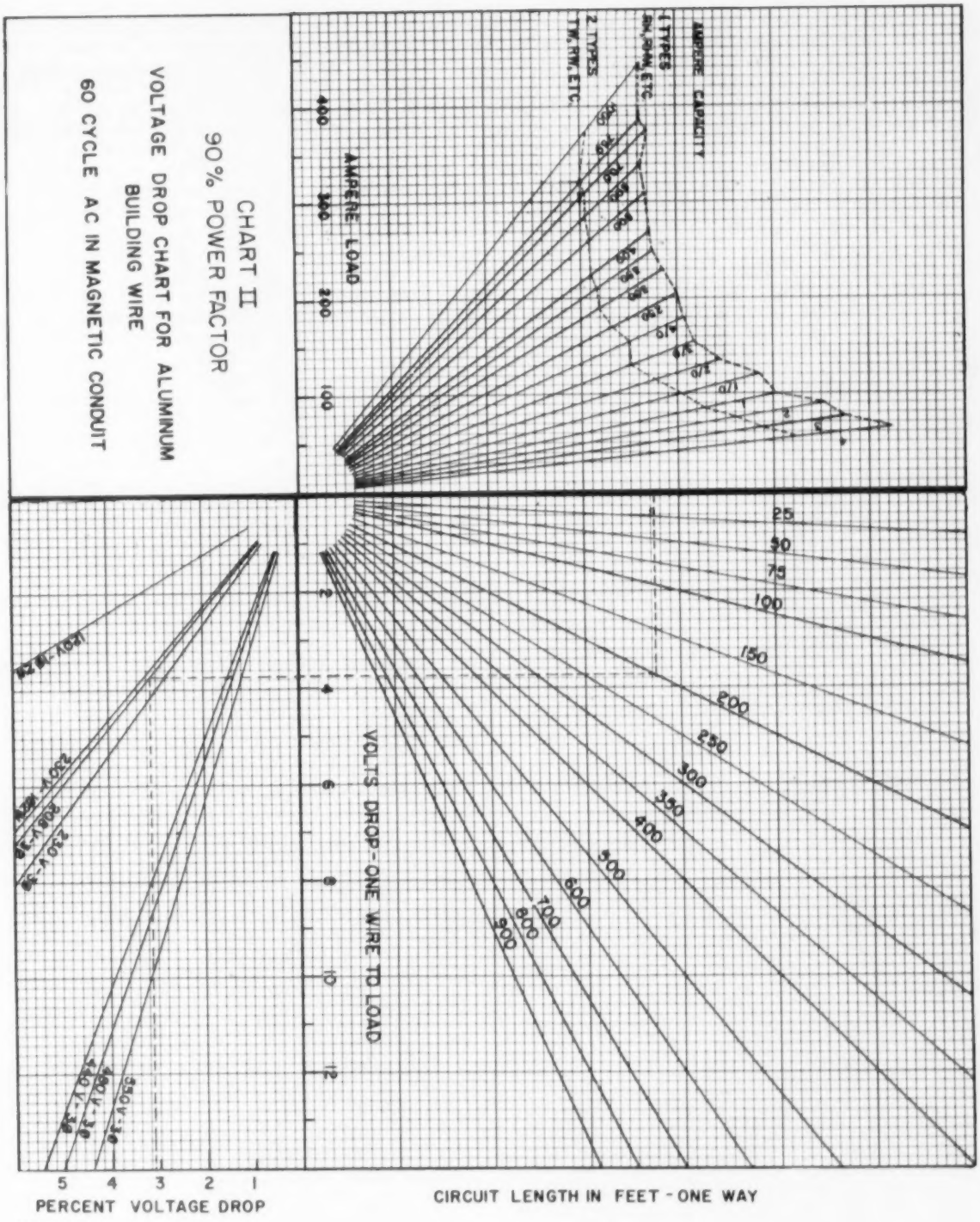
4. Circuit Voltage — 3-phase, 208 volts, phase-to-phase.

5. Allowable Voltage Drop—limited to 3% for power loads.

Select Chart III, the 80% Power Factor Chart. Follow the dotted line in this chart, as outlined below, to obtain the correct size and insulation of aluminum conductor and the percent voltage drop for the circuit under consideration.

Step 1.—Start at the 245-amp load point on the chart (left side).

Step 2—Project a line vertically upward until it intersects the 350 MCM, Type RH conductor curve. Note that the extreme ends of these conductor curves indicate the allowable current-carrying capacity of aluminum conductors



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with Type RH, RHW insulation. Somewhat smaller ampere capacity ratings for TW and RW insulation are indicated by the broken line crossing the conductor curves below the RH, RHW values. See Note 2 on the chart.

Step 3.—From this point of intersection in Step 2, project a line horizontally to the right until it meets the 200-ft circuit length curve (upper right).

Step 4.—Next, project a line vertically downward from the above intersection until it meets the 208-volt, 3-phase (circuit voltage) curve in the lower right quadrant.

Step 5.—From this junction with the circuit voltage curve, project a line horizontally to the right to the edge of the chart and read the percent voltage drop direct. In this case it is 3.1%.

A normal assumption in the above problem is that the conductors are to be installed in magnetic conduit. The same chart can be used if the conductors are to be installed in non-magnetic conduit such as aluminum. The only difference is that the voltage drop will be somewhat less due to a decrease in the inductive reactance of the circuit.

Linear Interpolation

By means of simple linear interpolation, the charts can be used for nominal circuit voltages not indicated. Such interpolation applies to only one set of curves (circuit voltage) in the lower right-hand section of the chart. If desired, permanent curves may be added for any voltage. For example, a 460-volt line would be drawn midway between the 440-volt and 480-volt curves.

To illustrate a problem involving interpolation, assume the 75 hp motor in the above example is rated 220 volts, 3-phase, rather than 208 volts. The full-load current of such a motor is 185 amps. Load current for the circuit would be 125% of 185 or 231 amps.

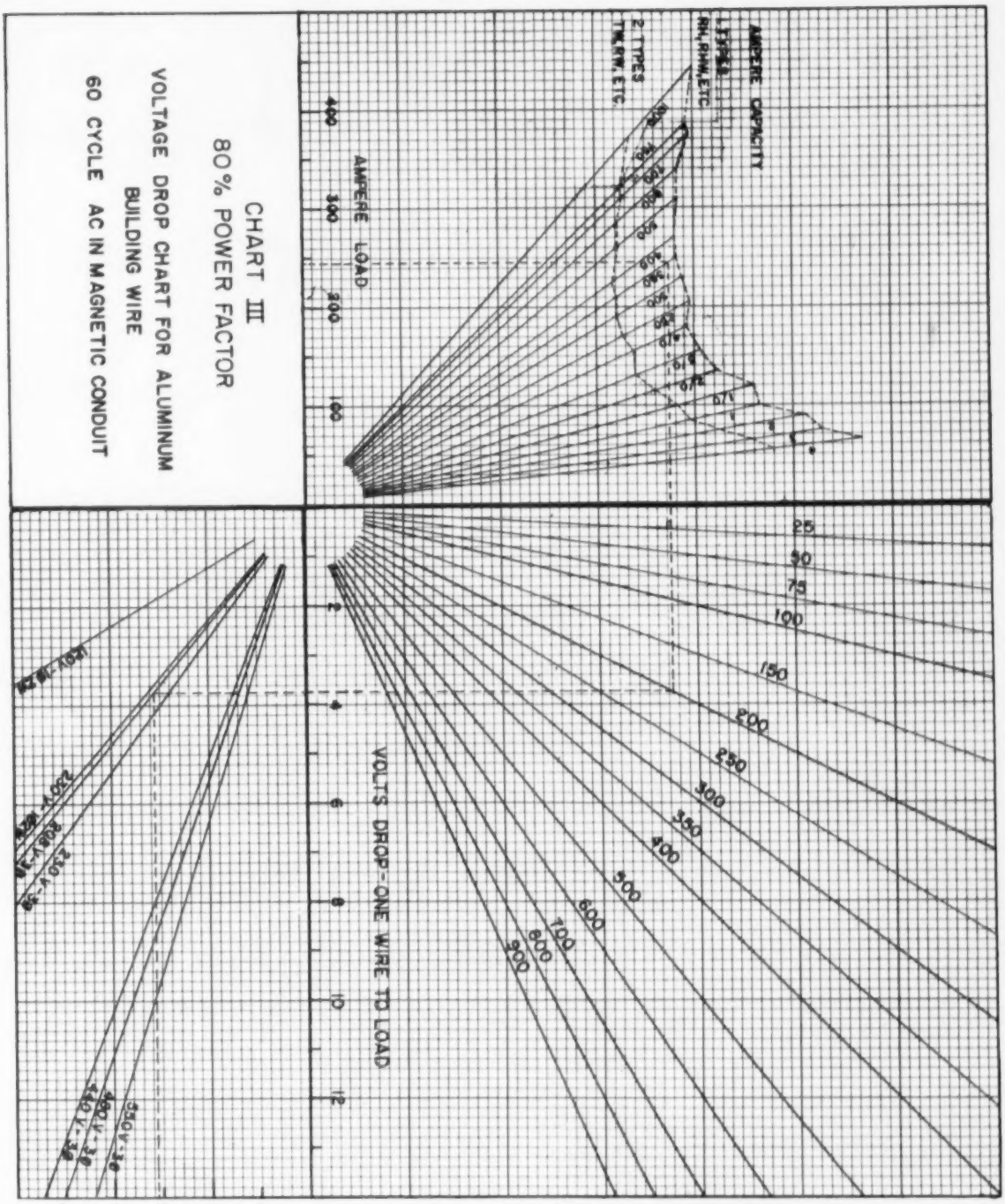
Follow the procedure outlined above and start at the 231-amp load point on the chart. Proceed through Steps 2 and 3. At Step 4, project down to a point slightly greater than one-third (actually $\frac{1}{3}$) the distance between the curves for 208 volts, 3-phase and 240 volts, 3-phase. From this point project horizontally to the right and read the 2.8% voltage drop answer at the edge of the chart.

All three charts are used in the same manner. Of prime importance, is the original selection of the proper chart to match the power factor of the circuit.

Table I—Resistance

Aluminum Cable—Class B—Concentric Strands
Ohms per 1000 Feet—75° C, 60 Cycles

Size MCM or AWG	D-C Resistance	A-C Resistance in Air or Non-Metallic Conduit	A-C Resistance in Metallic Conduit
1000	0.0212	0.0218	0.0252
750	0.0283	0.0287	0.0317
700	0.0303	0.0307	0.0336
600	0.0353	0.0357	0.0381
500	0.0424	0.0427	0.0449
400	0.0530	0.0533	0.0551
350	0.0605	0.0607	0.0623
300	0.0706	0.0708	0.0720
250	0.0847	0.0849	0.0864
4/0	0.101	0.101	0.102
3/0	0.126	0.126	0.127
2/0	0.159	0.159	0.159
1/0	0.201	0.201	0.201
1	0.253	0.253	0.253
2	0.319	0.319	0.319
3	0.402	0.402	0.402
4	0.508	0.508	0.508
6	0.807	0.807	0.807
8	1.28	1.28	1.28
10	2.04	2.04	2.04
12	3.25	3.25	3.25



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ESTIMATING FORUM – IV

Operating Costs—Is A Job Expense List Necessary?

By **Ray Ashley,** *Research and Consulting Engineer, Oak Park, Ill.*

FIG. 1—DIRECT JOB EXPENSE LIST

The Beverley Machine Tool Plant

(Figures shown as percentage of job payroll)

Federal old age social security	1.5%
Federal unemployment contribution	0.3%
State unemployment contribution	2.7%
Workman's compensation	2.5%
Public liability, property damage, occupational disease, etc., insurance	1.5%
General insurances and benefit funds	6.0%
Association dues	1.0%
Tools—consumed and depreciated	3.0%
Engineering and drafting	3.0%
General supervision	3.0%
Total charge	23.5%

Note: Cartage to be billed as required.

QUESTION:

Is it always necessary to list all direct job costs (a) when preparing an estimate, and (b) when billing a cost-plus contract?

ANSWER:

(a) No. A lump-sum percentage may be prepared for estimating some types of small jobs.
(b) No. The contractor may have the buyer approve a lump-sum percentage.

DISCUSSION:

ESTIMATING. One may have certain types of jobs that are being figured regularly. A pertinent list of direct job costs can be prepared and from it a lump-sum markup established for such work.

For the run-of-mine small jobs, contractors usually have established percentages which serve as standards the same as labor units. The standard markup is varied according to the requirements of the individual job.

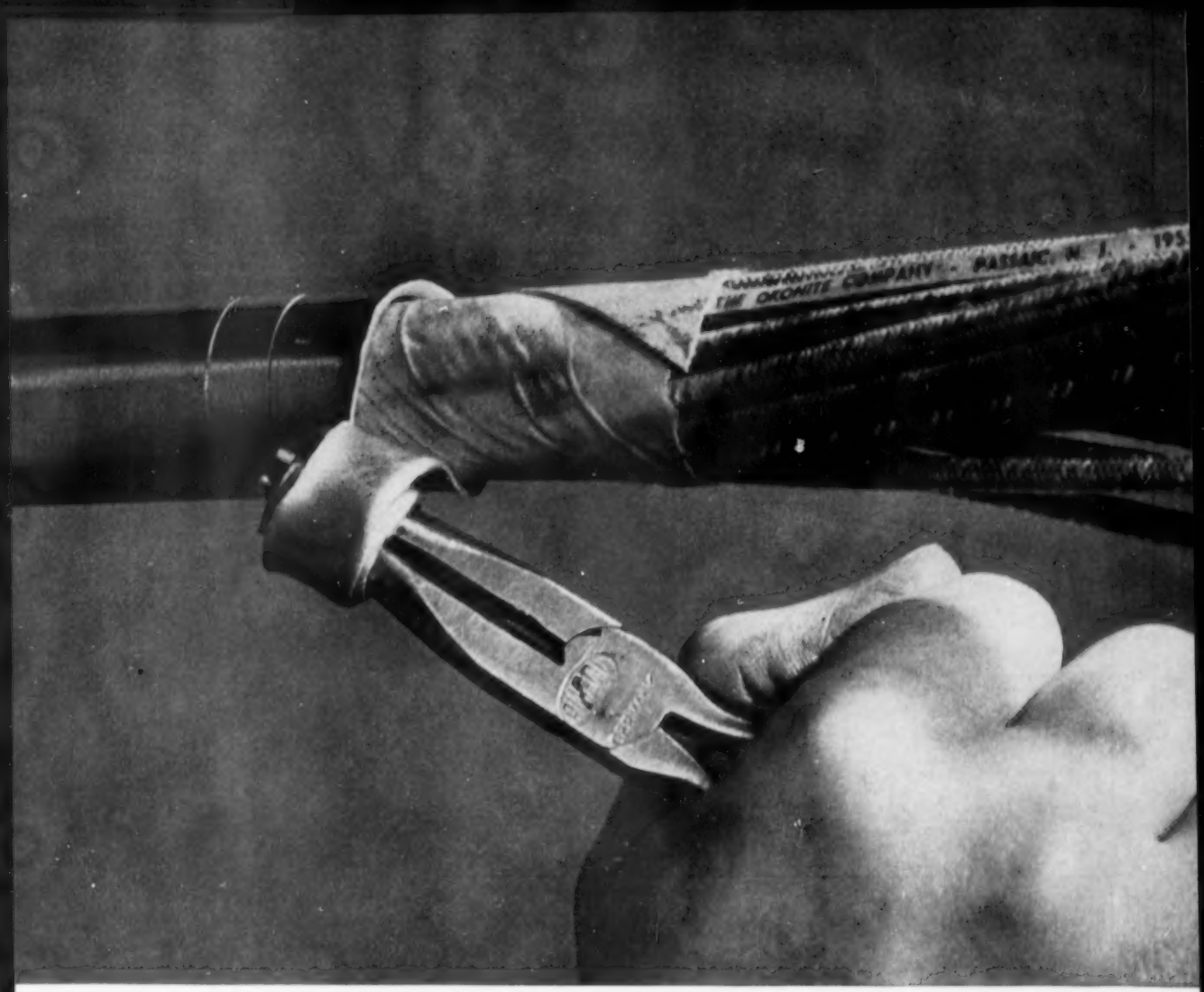
Large and special projects require a listing of all job costs. However, some basic costs such as engineering, estimating and supervision may be covered by using lump-sum percentages.

COST-PLUS CONTRACTS. For billing cost-plus projects, the contractor may prepare a list of job costs similar to that shown in Figure 1. This is approved when the contract is signed and a copy of the list is given to the buyer as part of the contract. When it comes time for billing, a lump-sum percentage, corresponding to that on the approved list, is used to cover all direct job costs.

Such an approved list of direct job costs not only facilitates billing, but avoids the possibility of disputes. On cost-plus projects misunderstandings frequently arise as to just what items are to be included in the cost. The buyer may expect that tools, engineering and supervision are a part of overhead and are included in the overhead percentage.

Regular customers can also be provided with lists of direct job costs. Again it is a case of avoiding misunderstandings as well as simplifying billing.

The next article in this series will cover the advisability of establishing your own accurate overhead costs.



ALUMINUM-SHEATHED CABLES

...light ...strong ...smaller diameter ...easy to install and terminate

A seamless aluminum sheath over Okonite cables provides a durable, conduit-type covering of high tensile strength. Yet this aluminum sheath is easily worked with standard conduit tools. It can be bent around obstructions . . . terminated at boxes, transformers, and the like . . . trained in trays . . . or supported by conventional brackets and cable clamps. Standard fittings are available. This low-cost alternate to rigid conduit is available with virtually any Okonite insulation such as rubber, plastic or varnished cambric.

Here are some important benefits of Okonite's aluminum-sheathed cables:

Reduced diameter and lighter weight.

Impervious barrier to liquids and vapors.

Excellent flame resistance.

Costs less than regular conduit installations.

Great mechanical strength, yet easily worked.

For complete data on Okotherm-insulated (silicone rubber compound) aluminum-sheathed cable for use in high ambients up to 200C (392F), contact your Okonite representative or write for Bulletin EC-1088A, The Okonite Company, Passaic, N. J. 4742

where there's electrical power . . . there's **OKONITE CABLE**

Common Code Problem

• Circuit Breaker as Disconnect

Branch-circuit circuit breakers may be used in a number of ways in motor branch circuits—as branch-circuit overcurrent protection, as motor disconnect, as motor controller or as a combination of these elements. The discussion here clarifies common applications of code requirements on motor circuit elements.

By B. A. McDonald

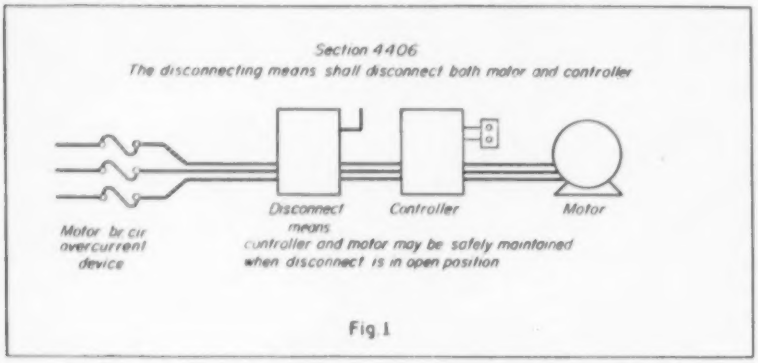

Section 4406
The disconnecting means shall disconnect both motor and controller
Disconnect means
Controller
Motor
Motor br cir overcurrent device
controller and motor may be safely maintained when disconnect is in open position

Fig. 1

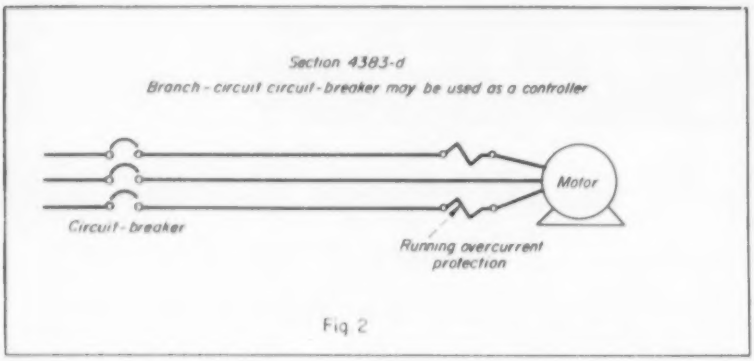


Fig. 2

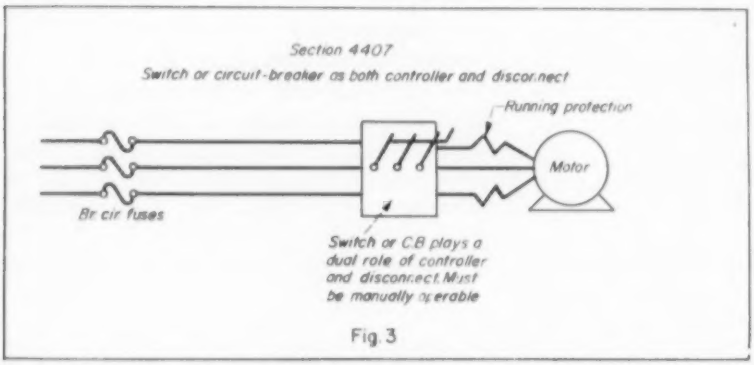

Section 4407
Switch or circuit-breaker as both controller and disconnect
Running protection
Motor
Br cir fuses
Switch or C.B plays a dual role of controller and disconnect. Must be manually operable

Fig. 3

Typical questions which arise about code rules on motor circuits are as follows:

Section 4402-a of the N.E.C. provides that for motors of ⅛ hp or less, the branch-circuit overcurrent device may serve as the disconnecting means. This might seem to imply that for motors larger than ⅛ hp, the branch circuit overcurrent device may not serve as the disconnecting means. But it is common to find motors fed directly from a motor control center of the pre-fabricated type, in which the branch circuit overcurrent protective device, a circuit breaker, is used as the disconnecting means. It disconnects both motor and controller, is usually in sight of the controller, and may be provided with a means for being locked in the open position. The question arises: Are these circuit breakers in prefabricated control centers acceptable as disconnecting means?

Other common questions involve the following:

a. Section 4406 states that the disconnecting means shall disconnect motor and controller.

b. Section 4383-d states that a branch-circuit circuit-breaker may be used as a controller.

c. Section 4407 states that a switch or circuit-breaker may serve as both controller and disconnecting means, if protected by an overcurrent device.

How can the three foregoing provisions be reconciled?

Answers to these questions are found in several sections of the code. The fundamental provision for a motor disconnecting means is expressed as follows by Section 4402:

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*George Kolbe, manager of Smithcraft's New York City team of Kolbe, Goren and Smith . . . part of the nationwide Smithcraft sales organization.

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TWOSOME — Top value, low cost, shallow and attractive. With new 45° x 45° compound shielding, or with plastic louvers, flanged polystyrene or various types of glass.

CIVIC — an architectural form . . . shallow, good-looking and in excellent taste. An extruded aluminum-framed unit.

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In addition to the TWOSOME and the CIVIC, Smithcraft's new developments include the FREEWAY and the EXECUTIVE. You'll find all four units useful to you in the selling and installing of lighting for today's interiors.

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Wherever good lighting is important, you'll find . . .

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EC-10

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☐ Please send me the monthly publication, "Light Side of the News", so that I can keep in touch with the latest trends in lighting.

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This...

instead of this

High bay lighting with Abolite is easier on the eyes

• In high bay lighting, Abolite open-top units eliminate uncomfortable contrast of bright lamps against dark background. 18% of the light is directed upward through Abolite's open top, washes out the deep shadows, gives lamps a soft background. 35° shielding of the lamp practically eliminates glare.

Open-top design also gives Abolite high bay units a self-cleaning action. Air circulates through the fixture, sweeps the reflecting surface clean, reduces lamp operating temperatures. As a result, lighting efficiency remains high, lamps last longer.

There are three Abolite uplight units for high bay lighting: 18" and 24" diameter Alzak fixtures for use with 400 and 1000 watt mercury lamps and 18" Alzak fixtures for 500 watt incandescent lamps (ideal for gymnasium lighting). For full details, write Abolite Lighting Division, The Jones Metal Products Co., West Lafayette, Ohio.

ABOLITE Lighting

"The disconnecting means shall be a motor-circuit switch, rated in horsepower, or a circuit-breaker, etc."

Section 4402-a is an exception to the fundamental rule which recognizes the branch-circuit overcurrent device as the disconnect for a stationary motor ⅛ hp or less. This overcurrent device could be either a fuse or a circuit-breaker. Since the circuit-breaker is recognized in the fundamental, it appears evident that the exception concerns the fuse. I do not believe there is any implication that a circuit-breaker could not function as the motor disconnect when the motor exceeded ⅛ hp in size.

In connection with the motor control center of the pre-fabricated type, it appears to me, under the conditions of use outlined, that a circuit breaker would satisfy the code provisions for a motor disconnect, provided the rating satisfied the provisions of Section 4342 which are covered by columns 7-8-9-10 of Table No. 20.

In order to clarify the provisions of Section 4406, 4383-d and 4407, I have endeavored to show that these rules are not inconsistent.

Fig. No. 1 illustrates the provisions of Section 4406. On this particular application we have the motor branch circuit overcurrent device, the disconnecting means, the controller and the motor, each independent of the other; and the disconnecting means disconnects both the motor and the controller.

Fig. No. 2 illustrates the provisions of Section 4383-d, which recognizes a branch-circuit circuit-breaker as a controller. Since this breaker becomes a controller, it appears that the provision of Section 4406 would require a disconnect ahead of the circuit-breaker. This logic is not correct since the fundamental expressed by Section 4402 recognizes a circuit-breaker as a disconnecting means. In other words the branch-circuit circuit-breaker may serve a dual role of controller and disconnect, provided Section 4407 is satisfied.

Fig. No. 3 illustrates the provisions of Section 4407 which recognizes a switch or circuit-breaker as both controller and disconnecting means. Here the switch or breaker not only controls the motor but also serves to disconnect the motor. When in the open position, it is dead except for the live terminal connections.

E.F. Luna: ~~Please note and return~~

ELECTRICAL TESTING LABORATORIES, INC.

2 EAST END AVENUE, NEW YORK 21
BUTTERFIELD 8-2600

TESTING • INSPECTIONS • CERTIFICATION

ELECTRICAL • PHYSICAL • CHEMICAL

July 17, 1957.

Mr. E.L. Gittleson,
Manager of Quality Control
Anaconda Wire & Cable Company
Hastings-on-Hudson 6, New York

Dear Mr. Gittleson:

Herewith is our Summary Report No. 366064 for 1956-1957, which brings together the results of the services we have rendered to your Company in this thirteenth contract year under your Quality Maintenance Program. As usual, our service covered your seven plants from coast to coast and consisted of the following:

1. Check or "audit" of inspection records at each plant, with results of some 121,500 tests examined. As in other years, every evidence that substandard material was rejected and so labelled, while only material in full compliance with relevant specifications went to the shipping room.

2. Witness of testing operations in each plant, with no criticism of technique, procedure or applicability of specification. As a "double check" - to our headquarters and tests made there by our personnel, with our equipment and our interpretation of specifications; result, satisfactory agreement.

3. Specimens of products on which plant tests had been witnessed were shipped

4. Calibration of all testing apparatus in the seven plants using ETL standards throughout. 352 pieces of testing equipment, some with as many as 5 ranges each, were checked; our certificate reports covered 366 pages. A fresh "ETL" red label was attached to each to indicate compliance with the accepted accuracy limits.

To summarize in one sentence: All of this checking by ETL furnishes once more, evidence of the effectiveness of your in-plant Quality Maintenance Program to insure that the products shipped are in full compliance with the relevant specifications.

Very truly yours,

Gordon Thompson

Gordon Thompson,
Chief Engineer.

GT/eg

E.L.G. Thanks – this certainly confirms that Anaconda Wire and Cable is made under the strictest quality control program in the industry

E.F.L

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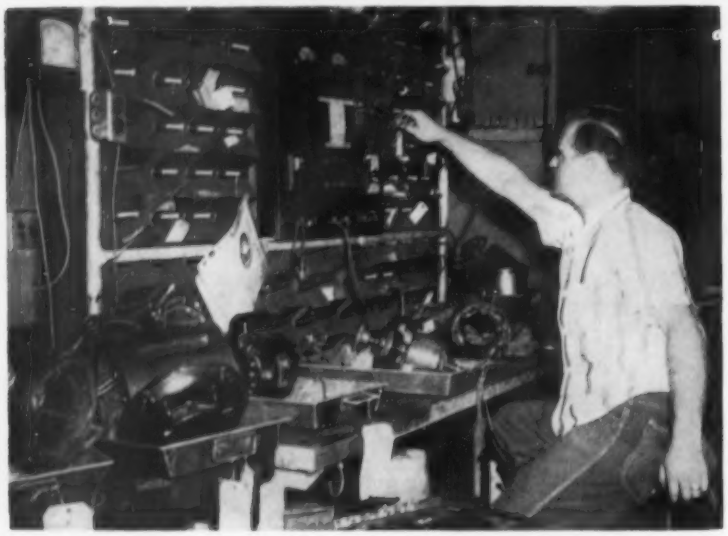
57423

Motor Shops



Parts Selection for Small Motor Jobs

Pre-repair analysis and parts selection for small motor jobs have added speed and efficiency to such work at the Central Armature Works Inc., Washington, D. C. Each small motor job is studied to determine the extent of work required and then the repair parts are selected for the job.

As shown in the photo, the mechanic at the small parts bench checks over each motor, then selects fittings, bearings, switches and other materials or parts from the bins in front of him. Each motor is placed in a pan along with the needed parts. Identifying tags, with instructions, are attached to the handles of the pans. Each pan moves in turn to a mechanic who can start work on the motor.

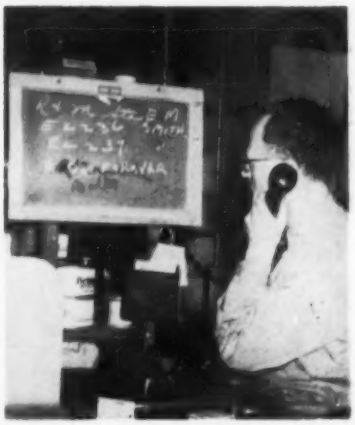
The small parts bench is arranged with the various repair parts in small bins for ready identification and selection. According to Walter Bailer, shop foreman, this type of pre-work job assembly avoids loss of materials and saves loss of time and effort.

Spare Parts Facilitate Armature Winding

Uncoiling spring wire is no longer an unwieldly and awkward operation at the Central Armature Works Inc., Washington, D. C., for a combination holding and braking device has been made there, from spare parts, to greatly simplify the job of winding armatures.

The spool, shown in the photograph, is mounted on a steel rod extension bolted to an upright arm and base made of sheet steel. To eliminate backlash, braking of the spool's rotation is accomplished by a thumbscrew which tightens a sheet-metal spring against the spool surface. The spool feeds the winding machine through a metal swivel arm attached to the machine's frame and the wire runs through a guide on this swivel arm to the armature being wound. Constant tension is assured by the downward pressure exerted on the wire because of the arm's weight. This improvised device feeds the wire to the armature at the constant tension and angle required by the winder and eliminates the knotty problems created by unraveled spring wire.

SPOOL AND SWIVEL ARM shown in operation as mechanic feeds spring wire.



Blackboard Notes Speed Job Orders

A blackboard is used to keep notes on immediate replacement needs within full view of the ordering clerk at the Eisenhardt Electric Motor Repair Service, Pennsauken, N. J. "Anytime that an employee or mechanic finds an immediate or urgent need for any type of material or item that is used in our shop, he writes it on a blackboard located near our ordering desk," explains Milt Eisenhardt. "Even though we take inventory frequently and try to keep a minimum stock of most items, there are times when we need something that we ordinarily do not stock or that we no longer have in stock. And these items are chalked on the board by an employee while he is thinking of them."

The ordering clerk makes it his business to order the listed items as quickly as possible. Upon placing the order, he erases the item from the blackboard thereby notifying the particular employee that the order has been taken care of. The board also serves as a notice place for recording rush jobs and pick-up jobs to alert employees of priority work in the shop.

Meet Mr. PLUS

Your Westinghouse distributor

Follow him through the next 4 pages

DP-5029-AR

Mr. PLUS

Successful local business man PLUS the broad Westinghouse line PLUS local stock service PLUS top-flight engineering support

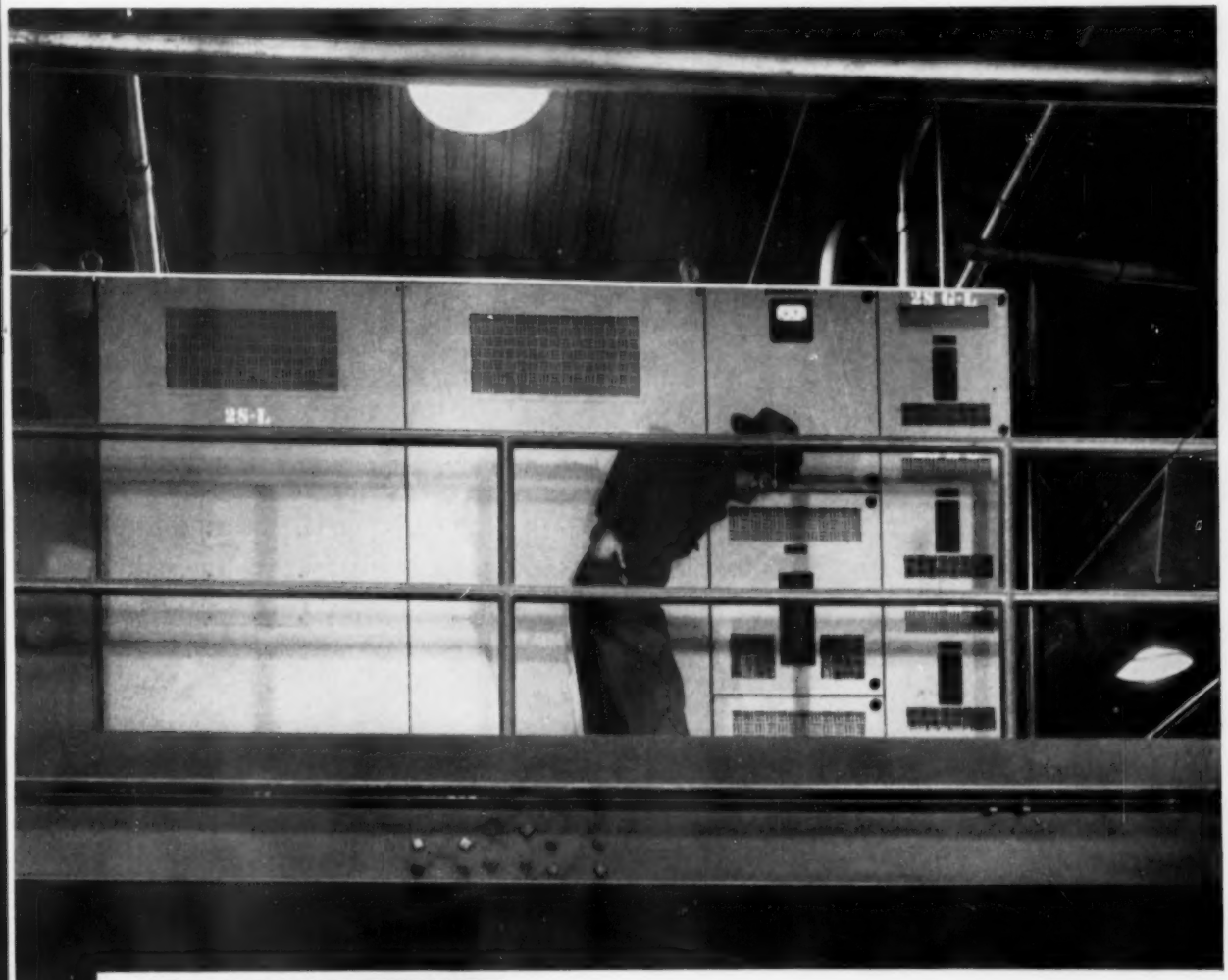
When you buy electrical apparatus from your local Westinghouse distributor, you are dealing with a reputable business neighbor. He has just as much at stake on each transaction as you have.

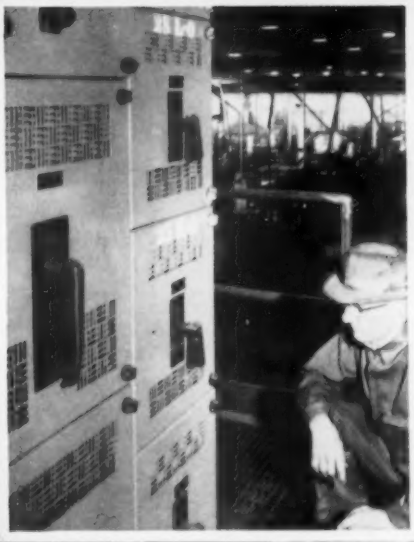
MR. PLUS *has* got something the other electrical suppliers have not. He can promptly fill the greatest variety of electrical construction needs with the best of apparatus for every need, backed up by a corps of electrical specialists . . . the Westinghouse team.

DP-5029-B

YOU CAN BE SURE... IF IT'S

Westinghouse





"Air Borne" Power Centers

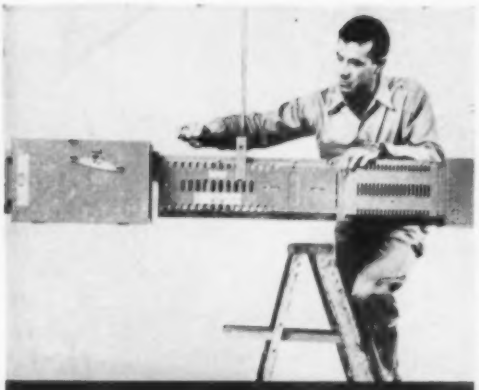
Mounted overhead, this Westinghouse power center solved several problems for the electrical contractor and for his customer. Space saving is obvious, using an area otherwise totally wasted. Incoming high voltage comes directly to use areas. Avoids costly voltage drop.

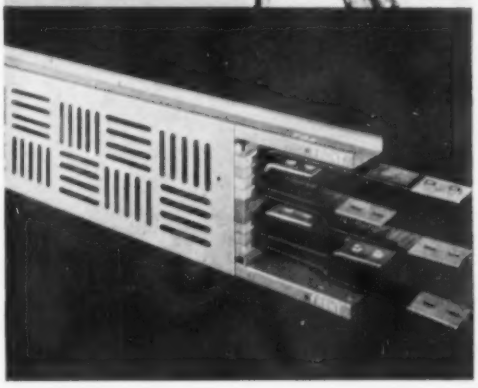
Unitized design enables electrical engineers to lay out a service combination to fit any need, and the contractor to install it in jig time. Factory wiring and assembly are so complete that on-the-job work is reduced to a cost-saving minimum.

DP-5029-C

THE "EXPRESS" BUS FOR POWER DISTRIBUTION

Simple to install, safe to wire, economical to use





Westinghouse bus duct truly is the "express" medium for power distribution. In conventional Westinghouse plug-in duct, outlets are spaced every 12 inches giving the ultimate in design flexibility for plant layout. With Westinghouse low-impedance bus duct long runs can be laid out with a minimum of concern over voltage drops.

New Life-Line Uni-Bus combines the features of low-impedance and plug-in duct in one busway. The unique flexible connector and safety devices add up to make Uni-Bus industry's most outstanding busway system.

For anything electrical...

Mr. PLUS *will show you why..*

LIGHT IT RIGHT WITH WESTINGHOUSE

Because of carefully engineered design, there are Westinghouse fixtures to help you get the right light on every industrial situation. Right from the standpoint of proper levels of illumination for safety and efficient working conditions. Right from the maintenance man's viewpoint: less work for his crew, less overhead charged against his department. Right also in long-range cost . . . installation, maintenance, and ratio of light-per-watt expense in operation.

Whether you are the contractor who installs it or the plant engineer who has to live with it, make sure you light it right . . . with Westinghouse.

Westinghouse Electric Corporation, Box 868, Pittsburgh 30, Pa.

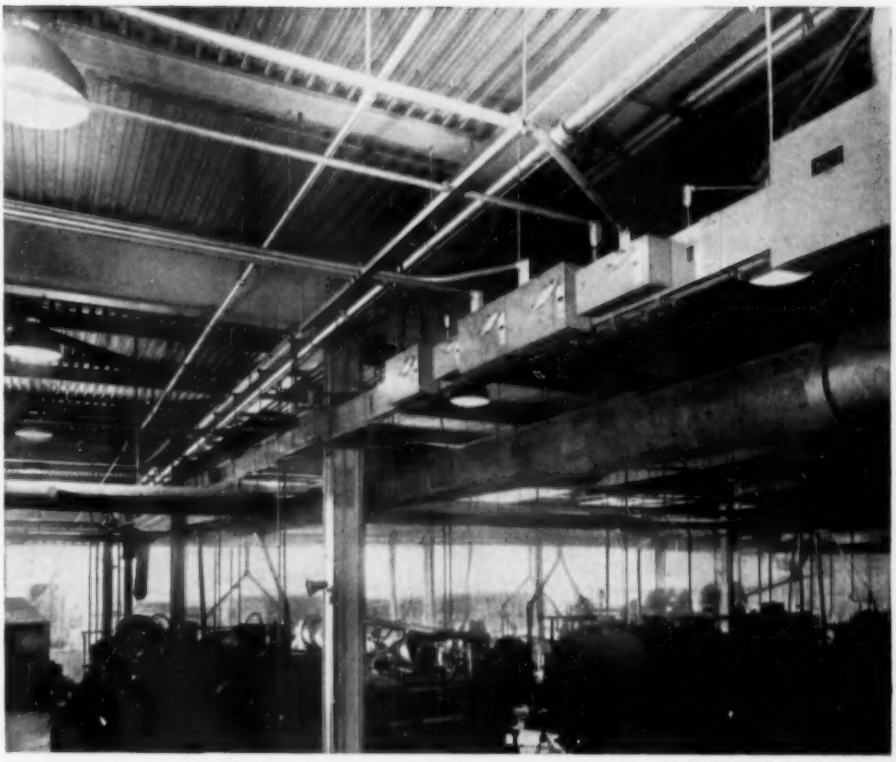
DP-5029-DR

Section of Life-Line Uni-Bus showing interlocked plug-in safety slide and power take-off device.

This installation shows Westinghouse plug-in duct used as a branch circuit supplying power to several machines. Easily changed take-off devices allow the relocation of any machine without power shut down to the others.

For complete information on Westinghouse Bus Duct or Uni-Bus, write for New Bus Duct Manual B-4272-C.

A section of Westinghouse low impedance Bus Duct of the type that is ideal for transmission of large amounts of power over long runs, insuring minimum voltage drop.



YOU CAN BE SURE... IF IT'S Westinghouse

VENTILATED HIGH BAY

The industrial plant pictured here is lighted right for efficiency, safety and economy with Westinghouse equipment similar to the high-bay fixture at left. Self-cooling, rugged, easy to keep clean. It lights right and lasts long.

LOCKLITE®

Patented lock-in feature of this Westinghouse fixture makes lamp changing or cleaning a simple matter. Highly efficient level of illumination. Ask your distributor salesman for a "Blue Bag" demonstration.

Write or ask your "Mr. Plus" for Westinghouse bulletins detailing the type of lighting you need.

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UNSEEN
QUALITY
THAT WORKS FOR YOU
IN EVERY
INSTALLATION

QUAD
AISLE-STOCK
REFLECTORS
for every

- SHELVING
- BIN or
- SIMILAR LIGHTING REQUIREMENT

Except for excellence of appearance you don't see the Quad reflector quality that is built-in—but it is there, in full measure.

For example, when you install Quad-Aisle-Stock Reflectors you give your customers units that daily demonstrate their quality through durability. These units are accurately formed of heavy gauge steel, porcelain enameled with ground coat and white inside and outside.

You give your customers units that provide a wide spread of light downward and outward to each side of aisle—that provide lighting for upper shelving and that have an eye shielding feature because of lower light cut-off angle at each end of reflector. Ask for catalog No. 10.

QUADRANGLE MFG. CO.
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Envelope Rack Used As Wire Holder

Quick and efficient dispensing of winding wire has been achieved at the Fairfax Electric Motor & Armature Company of Fairfax, Va., by converting a discarded envelope rack into a practical and useful holder for wire spools.

As illustrated, the former envelope rack is made of steel trays mounted on a large angle iron frame which is supported by casters to facilitate transportation of

SUPPORTED BY an angle iron base which rolls on casters, the rack is conveniently positioned in front of the winding operation.

the rack to any part of the shop. The frame is notched, allowing the trays which hold a number of wire spools to be raised or lowered to the most convenient position. The larger wire spools are accommodated on the reverse side of the steel frame, where the trays have been removed, by placing a steel bar through the center and hanging them on the frame's supporting notches. These spools can also be adjusted to the most desirable height and rotate easily on spindles so that they can directly feed a winding machine.

Simple Mediums "Dress Up" Motor Shop's Sales Counter

Customers entering the Penn Electric Motor Company's attractive over-the-counter sales-and-service lobby in Philadelphia are impressed with attractive display boards and neat stock bins which may be inspected by glancing down

UL approved for direct cable burial, Rome's FlexAll makes it easy for you to keep the wiring out of sight.

How Rome's multi-purpose UF cable can help you "sell up" outdoor lighting

and get those extra wiring jobs that mean more profit

By "selling up" when contracting to wire a home, you can increase the amount of extra lighting you install—such as carriage lamps—and thereby boost your profits.

Rome's FlexAll—a nonmetallic sheathed UF cable—can help you get a larger number of outdoor residential lighting jobs. Low in price and easy to install, FlexAll reduces your installation costs and enables you to quote a more attractive price when "selling up" additional lighting.

Installs easily, lasts for years. FlexAll, when provided with overcurrent protection, is ideally suited for direct burial in the earth and its flexibility makes it easy to handle. Insulated with Rome Synthinol (polyvinyl chloride) thermoplastic compound, FlexAll provides exceptional resistance to the corrosive elements in the earth. In addition, it has high dielectric strength and excellent aging characteristics.

Helps you to "sell up." Merchandise your services, don't just make them available. Sell your customers on filling their future needs *now*. Get that extra wiring—lights for the barbecue pit—gate lights—post lanterns—and *keep the wiring out of sight*. FlexAll permits you to put more wiring into many of your residential wiring jobs.

Specify Rome's FlexAll for your next job. Contact your nearest Rome Cable representative for more information—or write to Department 346, Rome Cable Corporation, Rome, New York.

ROME CABLE

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the best circuit breaker safety switch costs no more

You would expect to pay *much* more for this Heinemann 100 Ampere Safety Switch.

It's easier to install, more convenient to use. After trouble is cleared from the line, a flip of the handle restores service instantly. There's no hunting for fuses . . . no waiting to reset. Heinemann circuit breakers operate hydraulic-magnetically . . . permit safe use of the full capacity of your wiring at any temperature, without de-rating or the extra cost of larger switches. Inverse time delay allows necessary starting currents, prevents false-alarm tripping.

It's less than half the size and half the weight of comparably rated fused switches.

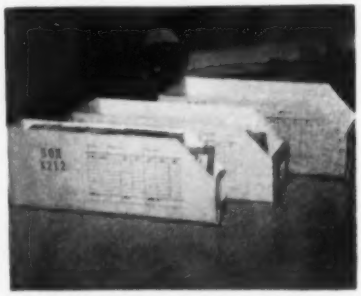
Yet, with all this extra value, the Heinemann Safety Switch costs no more. For descriptive literature, request Bulletin 1411.

ORDER NOW

For 120/240 volts AC, 3 wire; 120 volts AC 2 wire with insulated groundable neutral.
Cat. No. H-9002-70 enclosure with 70 amp. circuit breakers.
Cat. No. H-9002-100 enclosure with 100 amp. circuit breakers.

HEINEMANN ELECTRIC COMPANY *Circuit breakers*
129 Plum Street, Trenton 2, N. J.

GLAZED LETTERS in different sizes, colors and styles are purchased in precut sets; the sets coming as assortments of letters on cardboard sheets so that desired letters may be obtained merely by punching out the nearly-perforated units. Lettering may then be backed by an adhesive binder and positioned as desired in any combination and on any background.



STORAGE BOXES formed of corrugated cardboard come in several widths, so that parts of various sizes may be stocked in a container closely approximating the desired physical dimensions of the item. Shelf area is conserved as a result and, since replacement of damaged or soiled boxes is inexpensive, clean boxes keep stock shelves looking constantly neat.

the multiple aisles that adjoin the counter area. This layout, designed by part-owner Joe Previty, also features peg-board panels (on which various-shaped hooks may be spaced at will to support items of merchandise); the use of punch-out glazed-cardboard letters that may be affixed to the natural-wood valance to advertise the manufacturers represented by Penn products, plus the additional use of corrugated cardboard containers that hold small parts in neat array on the storage shelves.

The corrugated storage boxes, fabricated and obtained economically from a local source, are of several widths so that parts being stored may be placed in a container closely approximating the exact requirements of the items so stored. This method eliminates waste shelf space and, since the price of replac-

How Rome's direct burial UF cable can help you unearth extra wiring jobs

Don't overlook outdoor lighting as a profit-booster on your industrial-commercial wiring installations.

With the right cable, you will find it easier, for example, to "sell-up" such *extra* wiring as: floodlighting plant buildings; floodlights for parking areas; entrances; driveways; illuminated signs; perimeter security lights.

Rome's FlexAll—a nonmetallic sheathed cable—can help you get a larger number of these outdoor lighting jobs. Low in price and easy to install, FlexAll reduces installation costs and enables you to quote a more attractive price when "selling-up" additional lighting with concealed underground wiring.

Lasts for years. FlexAll, when provided with overcurrent protection, is ideally suited and UL approved for direct burial in the earth and its flexibility makes it easy to handle. Insulated with Rome Synthinol (polyvinyl chloride) thermoplastic compound, FlexAll provides exceptional resistance to the corrosive elements in the earth. In addition, it has high dielectric strength and excellent aging characteristics.

Merchandise your services by recommending FlexAll for that *extra* underground wiring. FlexAll helps you sell your customers on filling their future needs now—opens the door to more wiring profits for you.

Specify Rome's FlexAll for your next job. Contact your nearest Rome Cable representative for more information—or write to Department 348, Rome Cable Corporation, Rome, New York.

ROME CABLE

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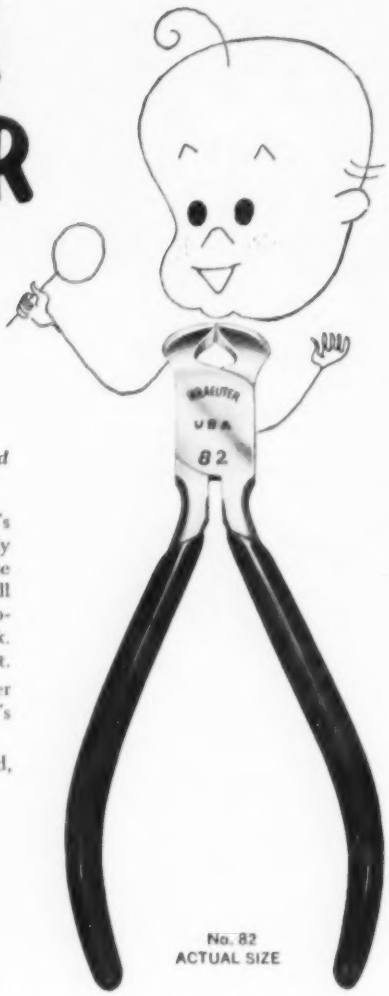
This is KRAEUTER'S

LITTLE NIPPER



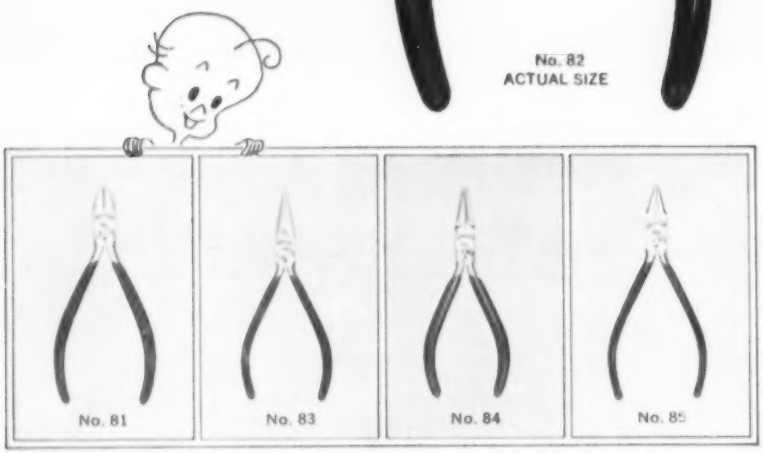
No. 82
ACTUAL SIZE

Only 4½" – but *all bite and precision.*

And below are Little Nipper's pals – Larry Long Nose, Rudy Round Nose, Frankie Flat Nose and Slick Cutter. *They're* full of fight, too. Precision drop-forged for precision work. Cushion grips at no extra cost.

The job goes easier and quicker with fine tools. And that's where Kraeuter comes in.

Sold *only* through recognized, legitimate distributors.



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BUY KRAEUTER
BUY AMERICAN

AS MODERN AS TOMORROW

kraeuter & co., inc

FOR 100 YEARS THE FINEST IN HAND TOOLS 1860-1960 ● NEWARK, N. J.

ing a container is in the order of only a few cents per carton, boxes may be economically replaced with new ones whenever the old containers become damaged or soiled to the extent of unsightliness (approximately every two or three years). As indicated, boxes are printed with a side index record that shows the names, addresses and phone numbers of the suppliers handling the items contained in the boxes (and also all previous price quotations) so it is a convenient matter to re-order parts as inventories approach normal minimum levels. Parts are identified on gummed labels which are affixed to the beveled front section of the carton, thereby providing further information for the salesman's assistance.

Shipping Crate Provides Protection for Motor

Armatures shipped in a box similar to the one illustrated are insured against any possible damage which might result from the unit rolling around on a rough floor or truck body, or from the windings being subjected to heavy bearing stresses due to the weight of the armature itself. As noted, the box is slightly wider and deeper than the stator so that, when the shafts are placed in the notched box-ends, free clearance between windings and box-sides or bottom is guaranteed. By nailing a metal strip over the shaft at either notch location, the armature is prevented from being removed unintentionally while in transit or storage; the box and armature can be handled as an integrated combination with slings or fork-lifts, and the repaired unit can be delivered from final testing station to customer's premises in this workmanship-protected condition. This method of shipping is standard procedure with the Electric Motor & Service Company of Steelton, Pa.

Time-saving convenience. No waiting for short lengths to be cut off reels. Buy only what you need to finish up the job.

Quick, easy handling. You don't need a truck to pick up the wire you need. Just throw one of these cartons in the front seat of your car.

All-round protection. No matter where you use short lengths on the job, these convenient Rome cartons will protect your wire up to the minute it is strung.

Need short lengths of wire to finish up a job?

Pick them up in these handy, convenient Rome cartons

For your convenience, Rome bare and weatherproof wire, Triplex and Duplex SD cable—in short lengths—are packaged in handy cartons.

Don't lug a full reel onto the job when all you need is a short length to finish up the installation. Just ask your Rome distributor for the size you need in one of Rome's easy-to-handle cartons. 140

Save this ad and use it as a handy buying guide for Rome wire and cable in short lengths.

Type	Size	No. of Strands	Conductor	Covering	Length	Package	Packaging	Approx. Wgt. Lbs.
Bare	14	Solid	Copper	None	1000′	Spool	1 per carton	13
Bare	12	Solid	Copper	None	1000′	Spool	1 per carton	20
Bare	10	Solid	Copper	None	500′	Spool	1 per carton	16
Bare	8	Solid	Copper	None	500′	Spool	4 per carton	105
Bare	8	7	Copper	None	500′	Spool	4 per carton	105
Bare	6	Solid	Copper	None	300′	Spool	4 per carton	105
Bare	6	7	Copper	None	300′	Spool	4 per carton	105
Bare	4	Solid	Copper	None	200′	Spool	4 per carton	105
Bare	4	7	Copper	None	200′	Spool	4 per carton	105
Bare	2	7	Copper	None	250′	Coil	1 per carton	51
Weatherproof	14	Solid	Copper	Roprene	500′	Coil	1 per carton	10
Weatherproof	12	Solid	Copper	Roprene	500′	Coil	1 per carton	14
Weatherproof	10	Solid	Copper	Roprene	500′	Coil	1 per carton	20
Weatherproof	8	Solid	Copper	Roprene	500′	Coil	1 per carton	34
Weatherproof	6	Solid	Copper	Roprene	500′	Coil	1 per carton	51
Weatherproof	14	Solid	Copper	TK	500′	Coil	1 per carton	13
Weatherproof	12	Solid	Copper	TK	500′	Coil	1 per carton	17
Weatherproof	10	Solid	Copper	TK	500′	Coil	1 per carton	27
Weatherproof	8	Solid	Copper	TK	500′	Coil	1 per carton	36
Weatherproof	6	Solid	Copper	TK	500′	Coil	1 per carton	54
Triplex SD	6	Solid	Aluminum	Roprene	500′	Coil	1 per carton	80
Triplex SD	6	7	and ACSR	or Rolene	500′	Coil	1 per carton	80
Triplex SD	4	Solid	"	"	500′	Coil	1 per carton	110
Triplex SD	4	7	"	"	500′	Coil	1 per carton	110
Duplex SD	6	7	"	"	500′	Coil	1 per carton	50
Duplex SD	4	7	"	"	500′	Coil	1 per carton	75

ROME CABLE

CORPORATION

SAVE
costly motor rewinds

PROTECT
valuable switch gear
and transformers

PREVENT
fire damage and
personnel injury

with this
ELECTRONIC
WARNING DEVICE
for 440 v. 3-phase
ungrounded systems

When a ground develops you are warned immediately if your system is protected with the DELTA-DESCO GROUND ALERT. A bright RED light flashes on and a BELL inside the instrument starts to ring. The red light continues to burn until the ground is corrected and the bell rings until switched off. When the system is ground-free a GREEN light burns continuously.

Low cost. Simple operation. Portable or stationary models.

Don't wait until trouble strikes.

WRITE FOR DESCRIPTIVE BOOKLET
—TODAY!

DELTA-DESCO COMPANIES
DELTA ENGINEERING SALES CO.
539 Aero Drive
SHREVEPORT,
LOUISIANA

For use with 440 v. 3-phase ungrounded systems

DELTA-DESCO
Electronic
GROUND ALERT

MANAGEMENT

PROTECT YOUR FUTURE

Corporation

PART II

By George Kossoy*

Second in a series of three articles for electrical contractors recommending security measures to provide for the continuity of the firm and the preservation of assets.

WHAT ABOUT corporations! Are they different? The existence of a corporation is generally perpetual; whereas, in the absence of an agreement, a partnership terminates when a partner dies. Accordingly, if you do not have a stockholders' agreement, then upon the death of a stockholder you are in business with his estate. This is a situation fraught with unpleasant possibilities.

Visualize, if you will, a corporation doing a substantial and prosperous business finding itself in a position where its stockholders include 10-year old infants who are represented by guardians or trustees. Visualize, if you will, going to a bank for a loan, and telling them that a substantial block of your stock is owned by an infant or by an incompetent child or adult. Unfortunately, this has happened before. Adequate planning can avoid this.

Stockholders have greater maneuverability than sole proprietors or members of partnerships in providing for their mutual protection. Among other things, their agreements may provide that: stock of a deceased stockholder shall be acquired by the corporation out of surplus, or by the surviving stockholders; any stockholder may bequeath his stock to a member of his family or to anyone else; no one may sell his stock without first offering it to the other stockholders. There are many other possibilities, but I won't take up your time by enumerating them. Each agreement must be tailored to each individual situation.

Corporate agreements, among other things, provide methods of dealing with two important questions: (1) How shall the interest of a stockholder be valued; and (2) how will payment for that interest be made?

The fixing of value must be studied carefully in each situation. It must be fair and realistic. Many questions must be answered before a valuation can be agreed upon. Do you wish to include good will as an asset; how do you wish to value inventory; work in process; jobs on the books that have not yet been started; and jobs that are completed but in litigation? These are just some of the problems of valuation that are common to this industry.

Once a method of valuation has been determined, the next question is how to provide for the purchase of the stock of the deceased stockholder. A stockholders' agreement which cannot be fulfilled for lack of funds is worthless. When proper provision for payment is made, both sides benefit. The surviving stockholder or stockholders acquire the business without interruption and without serious impairment of capi-

* Attorney-at-Law with Goldwater & Flynn, General Counsel for the Greater City Electrical Contractors Assn. of New York. From an address delivered at the Convention of the New York State Association of Electrical Contractors and Dealers, Inc.

SILENCE IS GOLDEN

a golden opportunity for you with...

NEW CIRCLE F NO-KLIK® SWITCH

Everyone is talking about the new innovation in light switches . . . the CIRCLE F *Quiet* one.

The CIRCLE F NO-KLIK® Quiet Switch is a superior mechanical switch (not a mercury switch) made of heavy sturdy Bakelite with special non-welding silver alloy contacts – operates on A.C. current *in any position* for both incandescent and fluorescent lamp loads. No other switch offers you a more golden opportunity to cash in on the quiet switch market than the CIRCLE F NO-KLIK® Quiet Switch. Contact your local Circle F representative or write Circle F direct for more information.

*3401 and 3403 – 15 Amps – 120 Volts A-C [L] – 15 Amps – 120-277 Volts A-C

There are Circle F NO-KLIK® Quiet Switches for Industrial Use, too. Identified by Red Moulded Covers on Switches.

**3421 and 3423 – 20 Amps – 120 Volts A-C [L] – 20 Amps – 120-277 Volts A-C only

3401*
15 AMPS – 120-277 Volts A.C.

3403*
15 AMPS – 120-277 Volts A.C.

3421**
20 AMPS – 120-277 Volts A.C.

3423**
20 AMPS – 120-277 Volts A.C.

Circle F Mfg. Co.

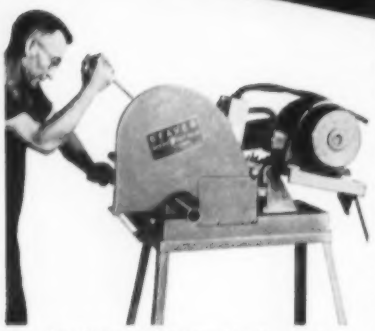
TRENTON 4, NEW JERSEY

For your wire requirements: Eastern Insulated Wire Corp. - A Subsidiary
Box 591, Trenton, N. J.

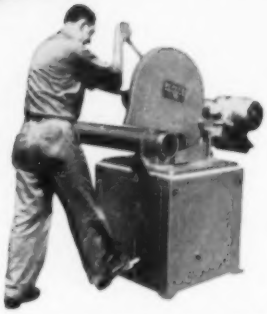
IN CANADA:
VERD-A-RAY
ELECTRIC
PRODUCTS LTD
MONTREAL 9.

FOR ONLY $540.00

MANY USERS ARE SAVING THOUSANDS OF DOLLARS IN METAL CUTTING COSTS!



No. 14 Beaver Abrasive Cutoff—$540



No. 20 Beaver Abrasive Cutoff—$995

OTHER BEAVER ABRASIVE CUTOFF MODELS

Any-Angle Cutoff ● Wet Cutoff ● Hi-Boy Cutoff ● Oscillating-Head Cutoff ● Trailer Mounted Cutoff (gas and electric driven)

LOOK AT THESE FABULOUS CUTTING TIMES!

2" Cold Rolled—10 seconds

5"x5"x⅝" Angle—12 seconds

3" Cast Iron Pipe—6 seconds

3" U Channel—4 seconds

4" Steel Pipe at a 45° Angle—12 seconds

1½" Aluminum Bar—2 seconds

¾" and 1¼" Copper Tubing—1 second

1" Formed Mild Steel—3 seconds

Aluminum and Brass Extrusions—1 to 3 seconds

1" Stainless Tubing—1 second

Send us samples of the tubing you wish cut. Sample cuts of your material will be returned to you with a time study and recommendations. We also invite you to visit our plant and see the different Beaver Abrasive Cutoff models in use.

CAN'T TELL IT ALL HERE!
Write for latest facts on all Beaver Machines!

BEAVER PIPE TOOLS INC.
279-500 Dana Ave
WARREN, OHIO

HAVE A CUTTING OR THREADING PROBLEM?
Let Our Engineering Research Department help you solve it.

tal, and the estate receives full value for the interest which the deceased stockholder worked so hard to create during his lifetime.

There are several methods to provide funds to pay for the deceased stockholder's interest. One is by the purchase of corporate owned insurance on the lives of the stockholders. This method makes certain that the corporation will have funds to acquire the stock interest, thereby protecting your family should you die first and also protecting you should you be the survivor.

I suggest this method for consideration, because I believe that the payment of annual premiums on corporate owned insurance represents a convenient method of funding the corporation's obligation under the stockholders' agreement.

I think the time has come when you, as employers, should realize that just as you set aside sums of money every week to insure the future welfare of your employees and to carry out the progressive thinking of this industry, you should likewise set aside sums of money each week, each month, or each year to insure the future of your business.

If the purchase of insurance to fund the potential obligation is not feasible, then an agreement can be prepared providing for a deferred payment plan with adequate collateral security for the estate. This will give the estate such security as the business can afford, while at the same time permitting the survivor to continue the operation of the corporation without interference or interruption.

ORLO W. OBERLANDER, secretary-treasurer of Oberlander Electric Co., Peoria, Ill., is also the firm's manager. Along with his many administrative responsibilities, Mr. Oberlander is in charge of bidding, procuring, and supervising all of the industrial work.

For Modern 2-Foot-Wide Troffers...

HOLOPHANE Presents a

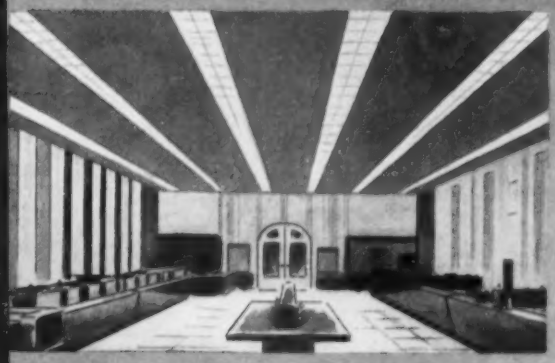
New *Flanged* Controlens*

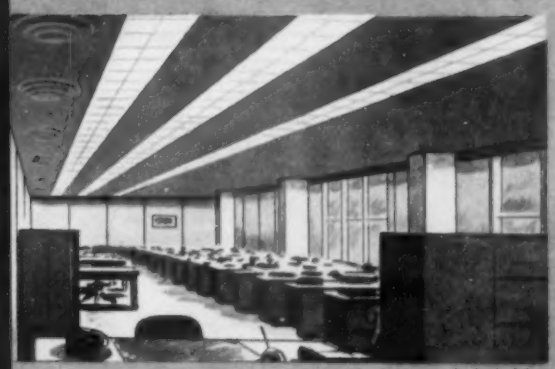
Photo: Courtesy
Litecontrol Corp.
Watertown, Mass.

No. 6025 ... Prismalume* Controlens

New Concept in Fluorescent Light Control Units...Now designed for available equipment†

Accents the New Look in Offices, Banks, Showrooms, Auditoriums, Public Buildings





†List of manufacturers who now make equipment for No. 6025 is available upon request.

Why are 2-Foot-Wide Troffers Desirable?

Because the wider lens produces high lighting efficiency with low brightness . . . assures greater visual comfort than usual narrower types . . . conforms with latest architectural techniques.

What are the Advantages of PRISMALUME?

The acrylic plastic, used in the construction of PRISMALUME CONTROLENS, provides crystal clarity, excellent color stability, lightness in weight, easy maintenance, greater safety.

How Does No. 6025 Set a New Trend?

The distinctive contour of the CONTROLENS avoids the monotony of large luminous panels. It is not a mere diffusing element, but a light-controlling lens, directing more light to the work, reducing brightness and glare. It makes possible higher illumination levels without sacrifice of comfort.

To be sure of Quality, look for the name HOLOPHANE *impressed on each piece . . .*

Holophane

HOLOPHANE
COMPANY, INC. • *Lighting Authorities Since 1898*
342 Madison Ave., New York 17, N.Y.
THE HOLOPHANE CO., LTD., 410 KIPLING AVE. SO., TORONTO 14, ONTARIO

*T.M.

CHECK HIDDEN FEATURES of Allis-Chalmers Individually Enclosed

LOW VOLTAGE BREAKERS

Safe, Easy to Inspect . . . Simple, Easy to Mount

1. Easily accessible — Removal of deep front cover permits inspection and maintenance of breaker from front or sides.

2. Easy breaker removal — Pull-out construction permits removal without disconnecting cables. Cable connections are accessible through entire front opening.

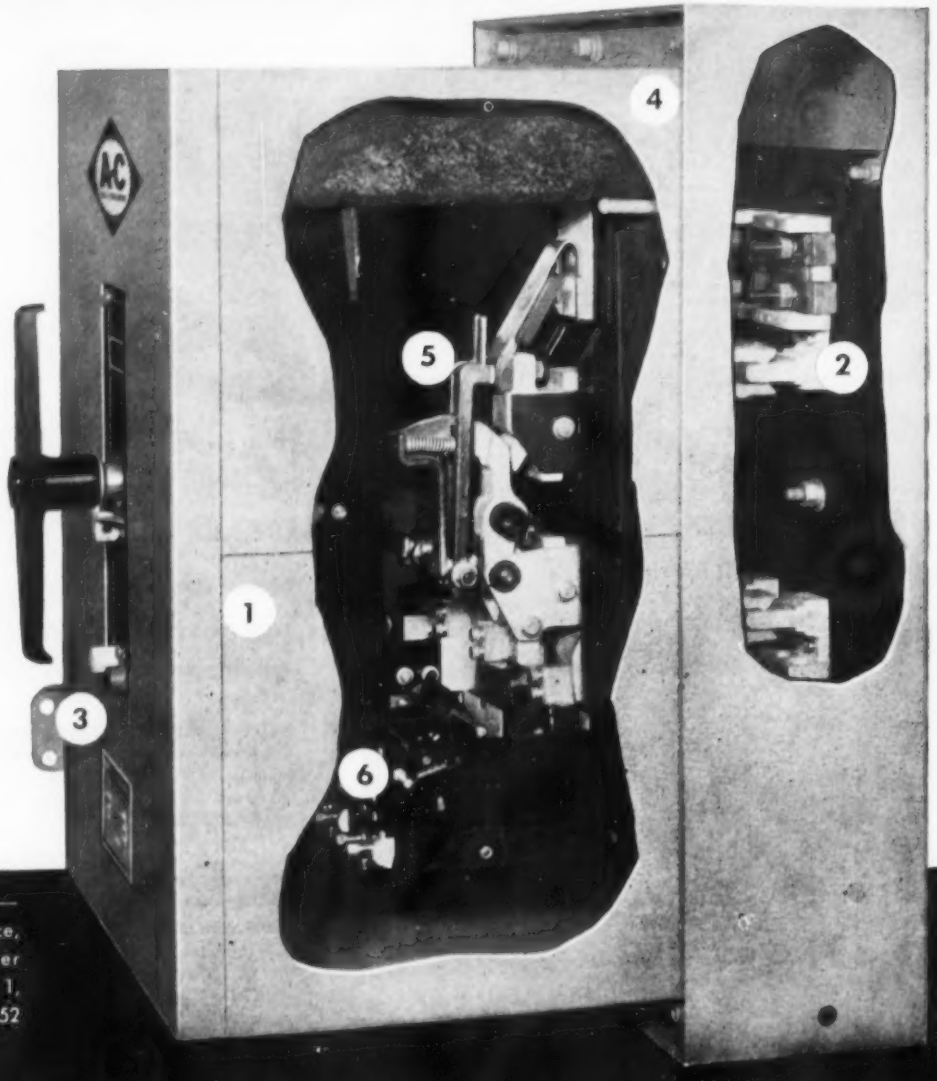
3. Safety Interlock — Prevents removal of cover while breaker contacts are closed.

4. Enclosures to meet your needs — Weather-proof or dust-proof as well as standard general purpose enclosures are available.

5. Long life contacts — There's no bounce—less erosion — due to high contact pressure with blow-on type action.

6. Accurate time-delay control — Hermetically sealed, positive displacement trip device is used.

For service to 600 volts ac, 1600 amperes continuous, 50,000 RMS amperes interrupting at 600 volts ac.



Get details, dimensions, prices — Contact your nearby A-C office, or write Allis-Chalmers, Power Equipment Division, Milwaukee 1, Wisconsin, for Bulletins 1888252 and 1888283.

PUBLIC BUILDINGS

INDUSTRIAL PLANTS

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ATHLETIC FIELDS

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THEATERS

ALLIS-CHALMERS

A-5220

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Product News

Distribution Transformers (1)

Types FCP and FSP make up a new line of fully protected distribution transformers for utility and industrial services. Full current protection for ratings of 10 to 100 kva is provided by type FCP, while type FSP has full current protection plus surge protection. Both types incorporate internal circuit breakers, internally mounted primary fuses, warning signal lamp, and emergency overload device. Circuit breakers are mounted directly above core and coils, submerged in oil. Series connected in low voltage windings, they are tripped by bimetallic elements which are sensitive to transformer winding temperatures. Type FSP transformers, in addition, have a valve type lightning arrester close to primary bushings to provide external air gap to ground.

Federal Pacific Electric Co., 5815 Third St., San Francisco 24, Calif.

Gear Motors (2)

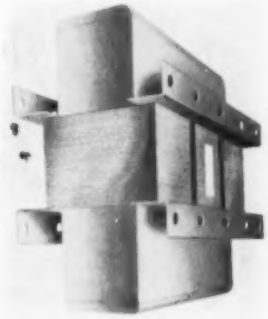
A new line of integral horsepower gear motors and related transmissions will be offered in three basic components: an integral-type unit design where gear and drive motor are packaged into a single unit; an all motor type which features the drive motor coupled to the gear reducer and mounted on a common carrier; and a separate helical speed reducer which may be used with a variety of prime movers. Featured in this line will be corrosion resistant housings, flexibility of mounting, simple speed changes through changes of pinion and gear in the first stage only, and built-in assembly and disassembly tooling. Three basic types of speed reduction will be available in the line: single reduction offset shaft in speed ranges from 780 to 350 rpm; double reduction concentric shaft for speeds from 350 to 37 rpm; and triple reduction concentric shafts for speeds from 30 to 13.5 rpm.

General Electric Co., Schenectady 5, N. Y.

Insulation (3)

Two new types of Epoxy-saturated Quinterra electrical insulations for Class "B" applications have highly purified asbestos bases which give them good electrical and thermal properties. Type 71 Quinterra is a high resin content product with a dielectric strength of over 700 volts per mil, high tensile strength, and a moisture absorption factor of less than 2%. This type is available in thicknesses of 4 and 5 mils, as tape, cut sheets, or rolls up to 36 in. wide. Type 72 Quinterra is a normal resin content insulation supplied in tapes, cut sheets, and rolls up to 36 in. wide.

Johns-Manville Corp., 22 East 40 St., New York, N. Y.



Transformers (4)

New three-phase power circuit transformers that can be mounted at the point of load have a low noise level of less than 45 db, and use class B insulation which reduces their size and weight. Ideal for hospitals, office buildings, stores, and other commercial buildings, the units have no dirt-catching cover, their cores being exposed to allow cooler operation.

Jefferson Electric Company, Bellwood, Ill.

Ceiling Lighting System (5)

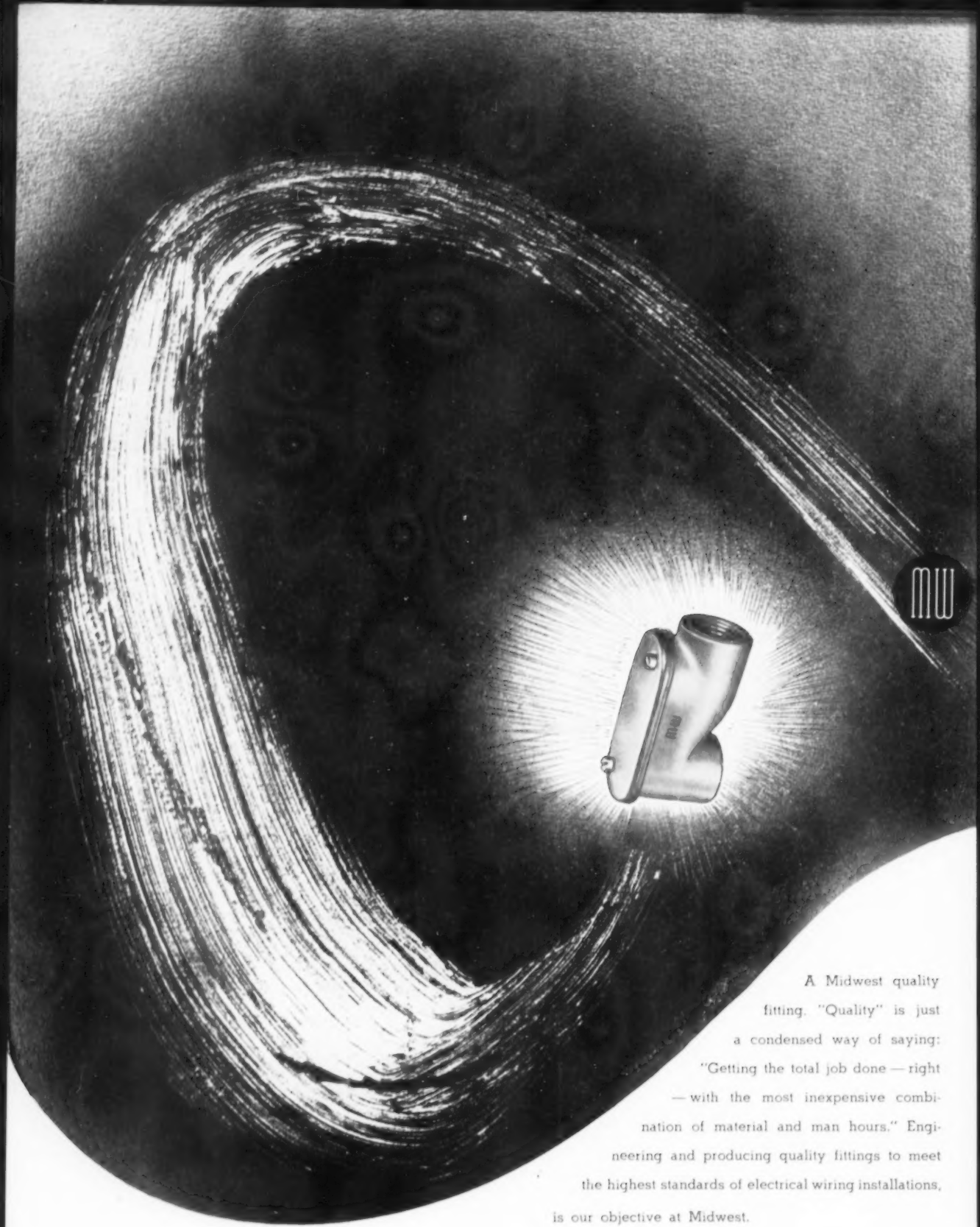
A new lighting-ceiling design has been developed that will help the building planner improve the environment, the utility, and the economics of building interiors. This development, called Smithcraft Integrated Lighting, provides a single system which incorporates lighting, acoustical control, and structural header sections to receive movable partitions. Giving complete freedom to the architect, the engineer and the contractor to place ducts, feeds, pipes, sprinklers and other services because it is in effect a large gridwork positioned below all structural members of the building and services, the new system has a high maintenance factor and provides 45° shielding perpendicular to the lamps as well as room sound deadening.

Smithcraft Lighting, Chelsea 50, Mass.

Motors (6)

Vertical weather-protected motors with enclosures built to NEMA Type II standard are available in squirrel cage and wound-rotor induction and synchronous types in ratings of 250 hp and up. Designed for outdoor applications on pumps and other vertical drives, the new motors' ventilating passages are constructed to minimize the entrance of rain, snow, and airborne particles. Further weatherproofing features found in these motors are specially designed space heaters, all-silicon rubber stator coil insulation, and permanent wire mesh type filters.

Allis-Chalmers Manufacturing Co., Milwaukee 1, Wis.



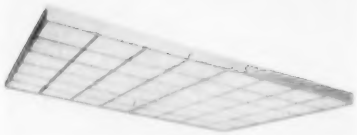
A Midwest quality fitting. "Quality" is just a condensed way of saying: "Getting the total job done — right — with the most inexpensive combination of material and man hours." Engineering and producing quality fittings to meet the highest standards of electrical wiring installations, is our objective at Midwest.

Midwest Electric Mfg. Company

MANUFACTURERS OF ELECTRICAL WIRING PRODUCTS

1639 W. WALNUT STREET

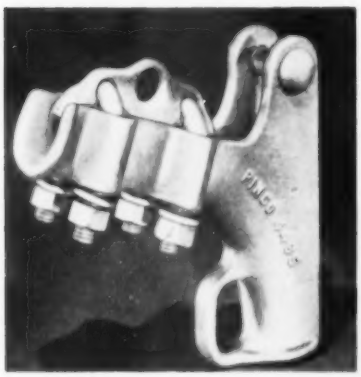
Chicago 12, Illinois



Luminous Ceiling (7)

New fixture units which collectively make a luminous ceiling are available in lengths of 97, 73, and 49 in. and widths of 24, 48, and 72 in. Enclosures are provided with "T" bar construction mechanically interlocked to support light diffusers and are made of 20 gauge cold rolled steel. Available with either vinyl diffusers or plastic louver diffusers, these fixtures are furnished with high power factor ETL-UL certified ballasts for operation on 60 cycle, 110-120-volt circuits. Prewired, the units bear UL-IBEW and AFL labels, and are known as "Panelaire".

Lighting Products Inc., Highland Park, Ill.



Strain Clamp (8)

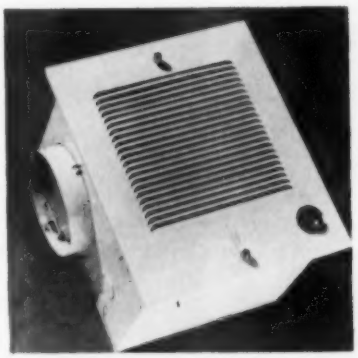
The keeper on the Pinco L4485 distribution strain clamp has been redesigned to have a built-in lift-off eye which simplifies assembly and disassembly of the unit. Made of hot dip galvanized malleable iron, and available with or without aluminum or copper liners, the clamp will accommodate cable seat diameters of up to 0.85 in.

The Porcelain Insulator Corp., Lima, N. Y.

Mercury Lamps (9)

Four new 1000-watt mercury lamps, which reportedly provide five percent more light than previous lamps of this type, use a special phosphor internal coating for more efficient conversion of ultra-violet radiation to white light. Identified as "White Mercury", the four new lamps will be listed as H1000-AW12, AW15, RW12, and RW15. Designed for use in areas where higher than usual mounting is required, all four types are made of heat-resistant glass making them especially adaptable to applications where moisture may strike the bulb.

General Electric Company, Nela Park, Cleveland 12, Ohio.

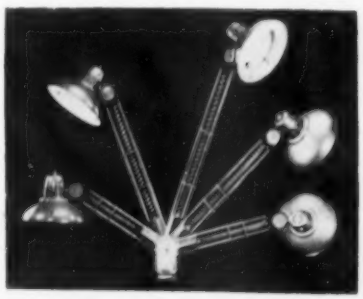


Automatic Blower (10)

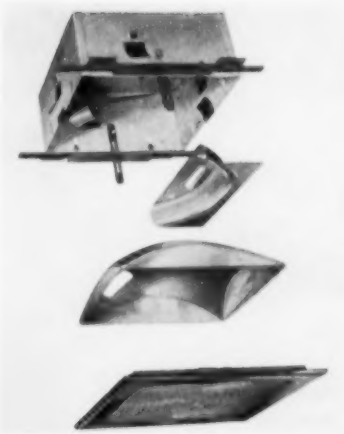
Designed especially for remodel work, this blower is equipped with automatic control and features easy installation and maintenance. Duct flange is removable and mounts from within the box while blower, humidistat, and junction box are easily disassembled and can be installed after plastering. The automatic humidistat which controls blower requires only seasonal setting for continuous steam-free operation. Unit is equipped with automatic overload protection and may be operated manually if desired.

West Wind Corp., 1800 Airport Way, Seattle, Wash.

(11)



LIGHTING UNIT, called the "Trombolite," adjusts to virtually an infinite number of working positions and combines incandescent light with fluorescent to provide good illumination for a large variety of uses. Amplex Corporation, 111 Water St., Brooklyn 1, N. Y.



Recessed Fixtures (12)

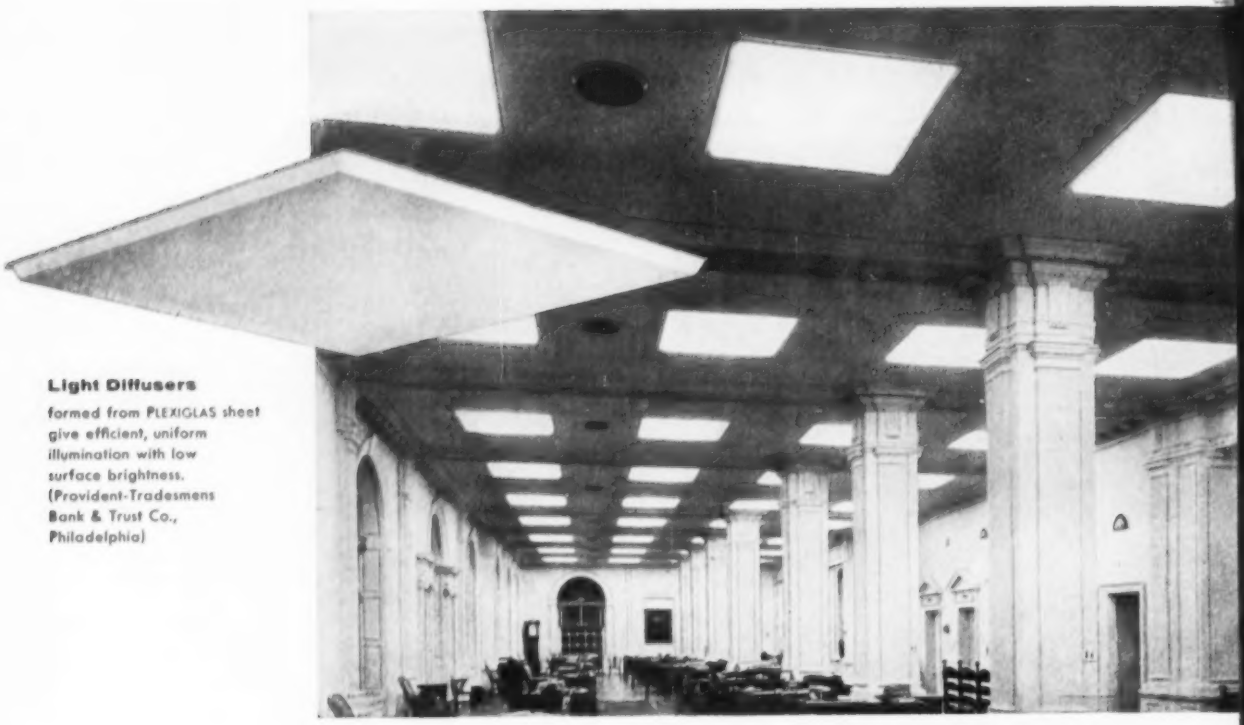
These internally prewired fixtures need no external outlet box and can be connected directly to building wires. Ideal for use in tight quarters in either old or new installations, they can be purchased in three sizes and any combination of four trim colors and four lens styles. 75-watt size has 8 by 8 by 5-in. housing; 100-watt is 10 by 10 by 5-in. housing; and 150-watt fixture has 12 by 12 by 5 in. housing. Lenses include Albalite, Fresnel, Drop Opal, and Bent Decorated.

John C. Virden Co., 6103 Longfellow Ave., Cleveland 3, Ohio.

Motor Control (13)

Full range stepless speed control can be obtained from this control unit, which converts 230 volts ac to half wave direct current. With this control, any dc motor can be adjusted from zero speed to rated rpm; preset speed is automatically maintained regardless of load changes or fluctuations. Available for ⅛, ¼, ⅓, ½, and ¾-hp motors, these units can be used with shunt or compound motors, with or without interpoles.

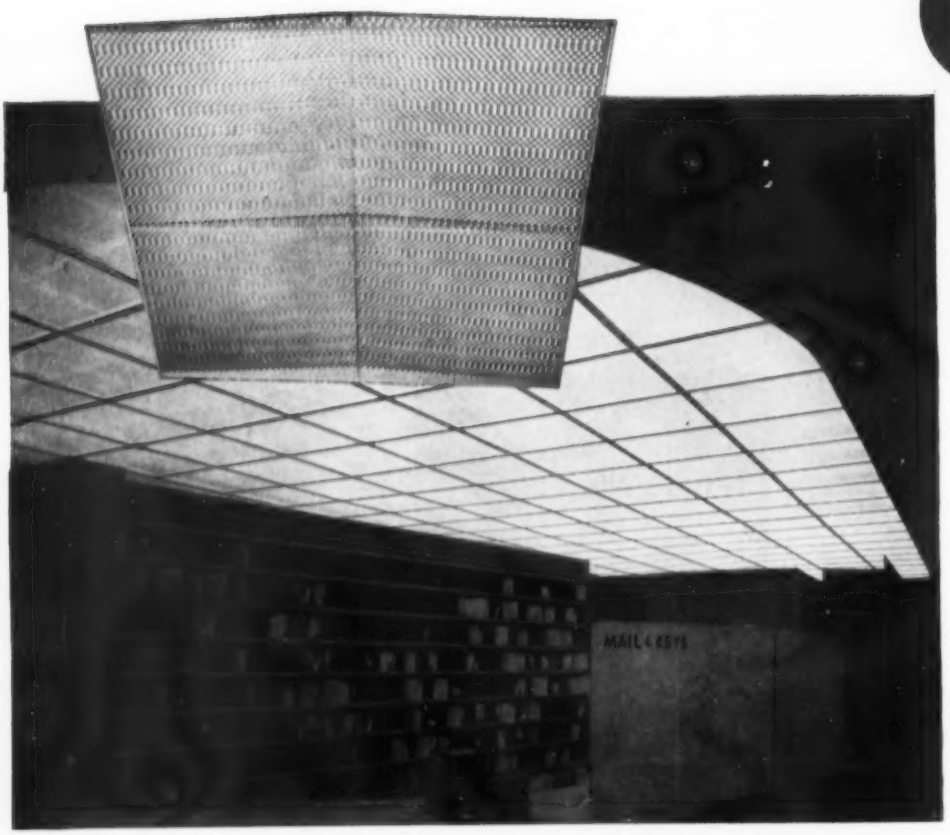
Acme Electric Corporation, Cuba, N. Y.



Light Diffusers

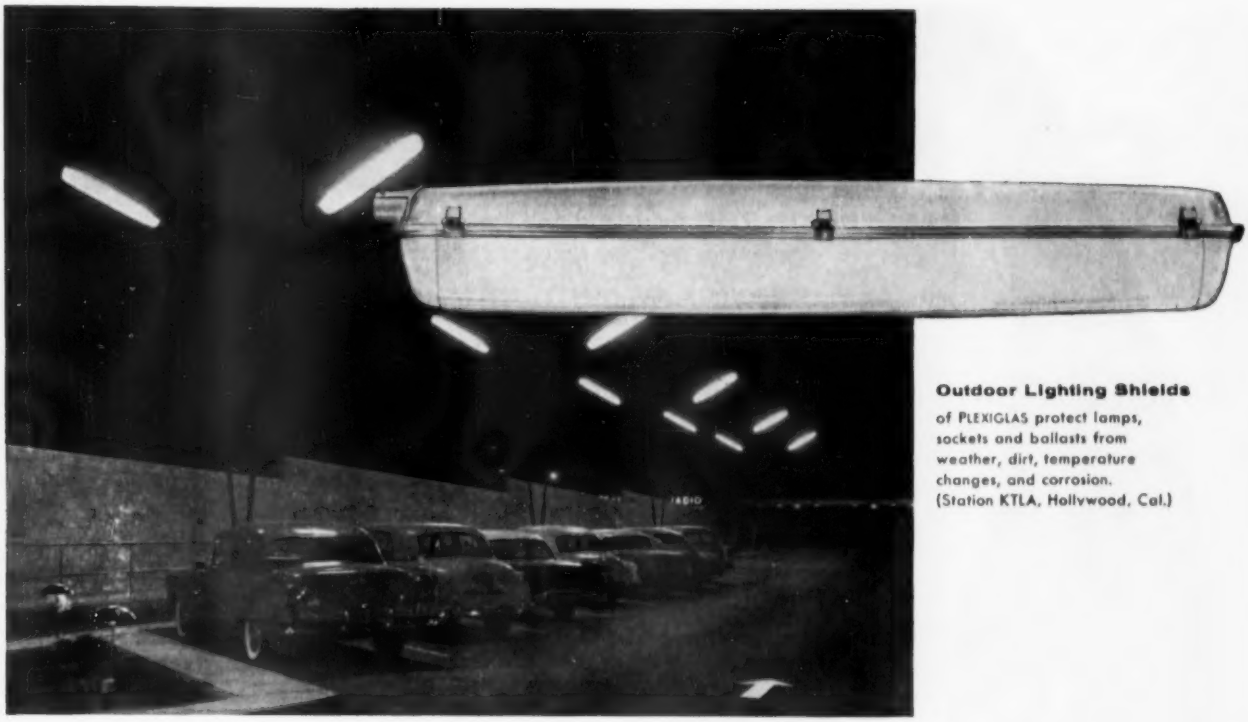
formed from PLEXIGLAS sheet give efficient, uniform illumination with low surface brightness. (Provident-Tradesmens Bank & Trust Co., Philadelphia)

PL



Light Control Lenses

made from PLEXIGLAS molding powder provide a high level of downward light with complete visual comfort, and give beauty and safety overhead. (Hotel Cleveland, Cleveland)



Outdoor Lighting Shields
of PLEXIGLAS protect lamps, sockets and ballasts from weather, dirt, temperature changes, and corrosion. (Station KTLA, Hollywood, Cal.)

EXIGLAS

...answer to almost any lighting problem

Indoors or outdoors . . . wherever light must be transmitted, controlled, diffused or protected . . . you'll find the job being done best by equipment that incorporates PLEXIGLAS® acrylic plastic. Lighting engineers, contractors, architects, and their clients, prefer such equipment because PLEXIGLAS has the following advantages:

- . . . **highest efficiency** in light transmission and diffusion
- . . . **light weight and strength,** for structural simplicity
- . . . **resistance to weather and breakage,** for long life and low maintenance
- . . . **economically formed or molded** to almost any shape and size
- . . **freedom from discoloration** by fluorescent light

These advantages add up to lighting of the highest quality.
To obtain them, be sure the equipment you select has diffusers, lenses or shields of PLEXIGLAS.
For sources of supply, just fill in and mail the coupon below.

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Canadian Distributor: *Crystal Glass & Plastics, Ltd., 130 Queen's Quay East, Toronto, Ontario, Canada*

ROHM & HAAS COMPANY
Washington Square
Philadelphia 5, Pa.

Please send the names of manufacturers of lighting equipment with PLEXIGLAS ☐ Diffusers, ☐ Light Control Lenses, ☐ Weather Shields.

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CABLES FOR TOP RELIABILITY—
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SERVICE CONDITIONS

Because no single construction can give the top dependability essential to control circuits, Triangle offers several types:

Rubber Insulated—Braid Covered
An economical construction for use in permanently dry locations not exposed to moisture, oils, grease, solvents or vapors.

Rubber Insulated—Neoprene Covered
Heat and moisture resistant compounds (RH-RW and RHW) or Triozone, ozone resisting butyl insulation covered with Trioprene, a jacket so tough it can be buried directly in the earth.

Thermoplastic Insulated—Thermoplastic Covered
Insulated either with Triolene, Triangle's polyethylene, or with Trioseal, Triangle's polyvinylchloride, and jacketed with Trioseal. Tough, flexible, with good electrical and aging properties and highly resistant to moisture, oils, acids, alkalis. May also be buried directly in the earth.

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For installations in very wet locations, including complete submersion.

TRIANGLE CONDUIT & CABLE CO., INC.
New Brunswick, New Jersey

Write for bulletin describing each type. Ask for Bulletin CC10-A

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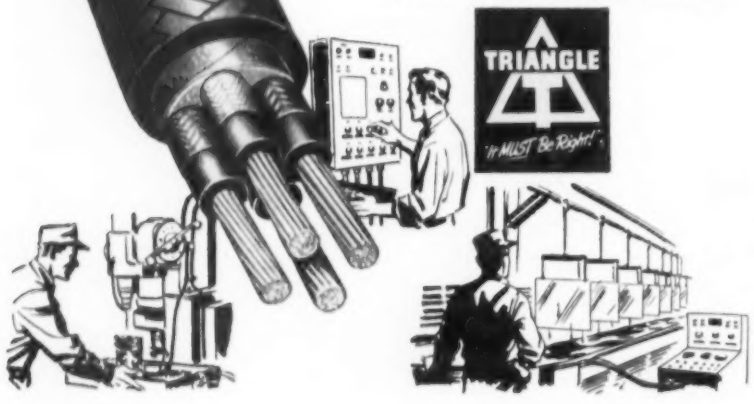

Ceiling Unit (14)

A square bowl ceiling unit suitable for either interior or exterior installation accommodates two 100-watt inside frosted lamps in angle type lamp holders. Projecting a shallow 4¼ in. from the ceiling, the fixture includes a cast aluminum hinged band with 18 gauge zinc-clad bonderized steel backplate and specular aluminum reflecting surface. Two captive held screws release the hinged band which swings to one side to facilitate relamping and cleaning.

McPhilben Manufacturing Co., Inc., Brooklyn 37, N. Y.

Wiring Troughs (15)

Added to a complete line of 4-in. by 4 in. wiring troughs and fittings are two new sections of 20-in. and 30-in. length with ½ in., ¾ in., 1 in., and 1¼ in. knockouts which are on 10-in. centers. These sectors come equipped with sealable screw-on covers and can be used with Wadsworth's complete line of 4-in. by 4-in. fittings. Besides these, there are also available 1-, 2-, 3-, 4-, and 5-ft sections of 8-in. by 8-in. inside dimensions. All troughs are approved by Underwriter's Laboratories.

Wadsworth Electric Manufacturing Co., Inc., Covington, Ky.

Master Switches (16)

A complete line of ac and dc master switches includes heavy-duty types for steel mill, crane, and power shovel applications, and a general duty model for small crane and conveyor applications. Available in two pieces—the operating head and switching unit—it is a new heavy-duty under-desk model with metal cam followers, pistol grip handle, ball and rod with spring return, and ball and rod with either 3 to 1 or 2 to 1 gear boxes. There is also manufactured a heavy-duty

surface mounted unit with overall dimensions of 8 by 8 by 11 in. and optional features including a foot-operated mechanism, ball and rod handle with off position latch or auxiliary contact mechanism, and and under-lever latch.

General Electric Company, Schenectady 5, N. Y.

(17)

A FULL LINE of vaportight lighting fixtures in pendent, ceiling, outlet box, wall and angle types with or without reflectors or guards are manufactured by the Spero Electric Corporation, 20500 St Clair Ave., Cleveland, Ohio

Aerial Ladder **(18)**

Automatic aerial ladder, an assembly that will support 1000 lbs 34 ft in the air without additional rigging, is recommended for all types of aerial work including utility repair work, municipal operations, and nursery work. Ordinarily mounted on a truck, the ladder can be completely removed from its mounting assembly for away-from-the-truck use. Heavy torsion springs aid positioning of the unit.

Gordon Metal Products Co., Plymouth, Ind.

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TRIANGLE CONDUIT & CABLE CO., INC.

New Brunswick, N. J.

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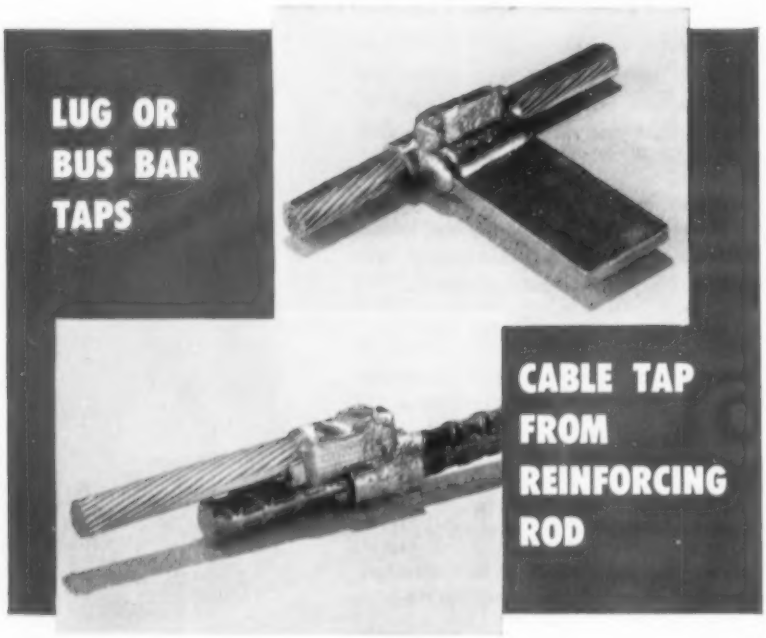
CABLE TAPS

with CADWELD® connections

—most versatile



CADWELD ELECTRICAL TAP CONNECTIONS can be made from: single or multiple cables, ground rod, reinforcing rod, bus bar or tubular bus.

Whenever or wherever a tap connection is required, CADWELD gives you a permanent 100% electrically efficient connection.

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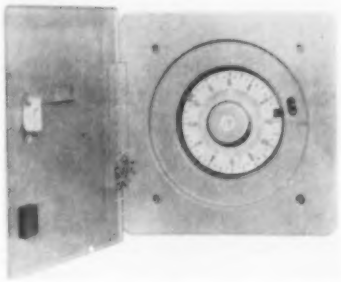
2070 E. 61st Place Cleveland 3, Ohio

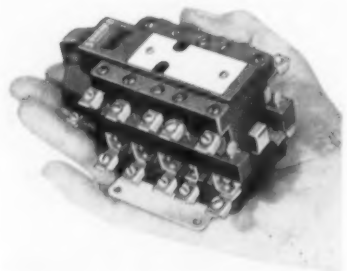
IN CANADA: ERICO INCORPORATED, 3571 Dundas St., West, Toronto 9, Ontario



Timer **(19)**

A 24-hour switch is designed to turn lights on and off at any preset time. Mounting flush within any wall, the timer, once set, repeats its automatic operation once every 24 hours closing the circuit for as short a period as 15 minutes or for as long as 23 hours. Length of timing cycle is easily changed by resetting on-off trippers. Capacity of controlling contacts is 1650 watts, 15 amps, 125 volts.

International Register Co., 2624 W. Washington Blvd., Chicago 6, Ill.



Relays **(20)**

In addition to the line of 4 and 6 contact Type D, 10-amp relays, there is now available a 10 contact size with a maximum of 6 normally open and 4 normally closed or 8 normally open and 2 normally closed contacts. Measuring only 5 in. high by 3 in. wide, all three sizes of the D relay have identical mounting hole dimensions for ease of electrical panel planning and interchangeability.

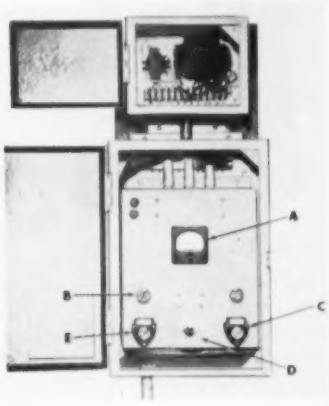
Square D Company, 4041 North Richards St., Milwaukee 12, Wis.

Industrial Fixtures **(21)**

The new "REGENT" features a porcelain enameled steel reflector and a heavy duty channel with certified HPF ballast and Miller turret type socket box construction permitting individual replacement of sockets spaced on 3½-in. centers.

Reflector provides 17° shielding and has apertures for upward light and ventilation. For Rapid Start, Slimline, or 800 ma Rapid Start operation, the fixtures are provided with reflector aligners and channel connectors for installation in continuous rows.

The Miller Co., Meriden, Conn.



Machine Controller **(22)**

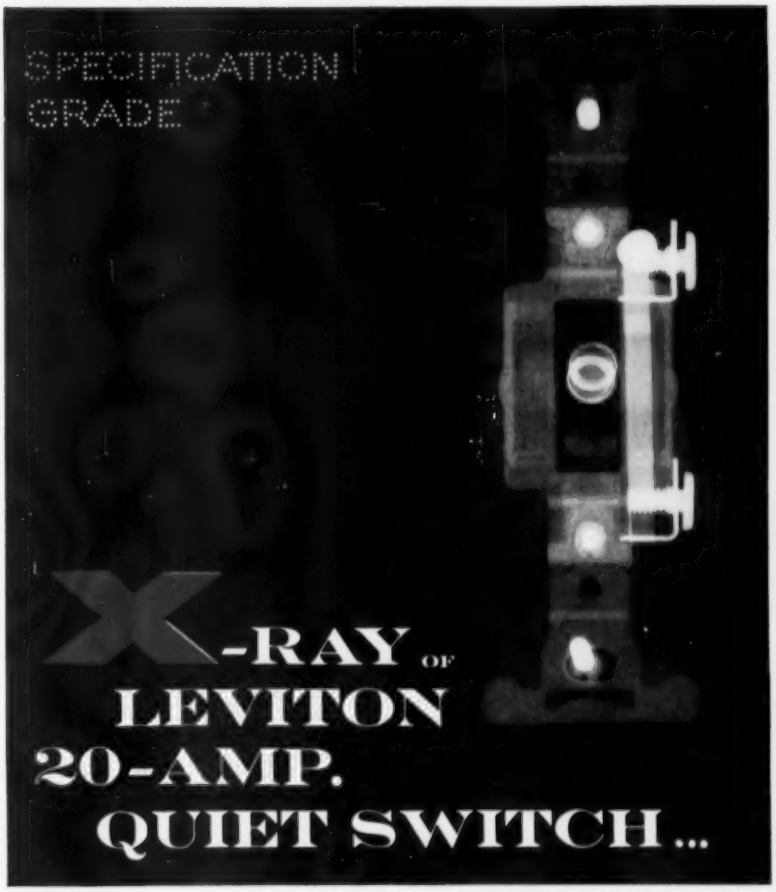
Machines can operate unattended when they are supervised by "TorqueTrol", a new automation device which controls tool feed, detects jamming, tool wear, faulty lubrication etc, and which stops the machine or sounds an alarm when dangerous operation occurs. Sensitive to power drawn by the machine, the unit stops the machine in milliseconds should an abnormal increase in loading occur. Voltage range of "TorqueTrol" is 110-440 volts ac, 50-60 cycles per second. Current range is 0.2-100 amps. Contact rating: SPDT, 5-amp non-inductive, 115 volts.

Electric Control Corporation, 1573 E. Forest Ave., Detroit 7, Mich.

Protective Device **(23)**

The "ADVAN-guard" is an internal thermally actuated device which is sensitive to both temperature and voltage as well as to current. Providing ballast protection for fluorescent lighting units, the protective device is sealed in the ballast housing and is preset to automatically trip out whenever the fluorescent lamp ballast operates at abnormal temperatures. Unit resets automatically and ballast resumes operation when heat decreases to normal operating temperatures. The device carries UL approval.

Advance Transformer Co., 2950 No. Western Ave., Chicago 18, Ill.



exposes superior quality, design and construction

Ratings: 20 A. — 120-277 V. Single pole, double pole and 3-way. AC only. Also available in 15 Amp. single pole and 3-way. Listed by UL, CSA and meets Federal specifications.

What you don't see counts, too! Leviton rigid quality controls assure you of specification grade 20 amp. heavy duty quiet switches that outperform your most demanding requirements. Compare this new Leviton switch on any basis you desire. You'll be convinced that grade for grade, performance for performance, Leviton superior quality stands out. Look at these special features . . .

Versatile — Fully enclosed flush tumbler switch . . . operates *in any position.*

Durable — Will withstand high inductive loads of fluorescent systems, and take full rated capacity of tungsten filament lamp loads . . . Takes full load currents up to 80% of the switch ratings for motor control.

Long-Lasting — Heavy gauge steel plaster ear straps riveted to housing, thereby providing a permanent assembly. 20-Amp. Quiet Switches will outlast ordinary 20-Amp. switches due to simpler, more durable construction.

Reliable — New design includes a magnetic arc-snuffing action at the fine silver contact points, assuring years of extra service.

Easy to Install — Large head brass terminal screws accommodate No. 10 conductor. Comes with mounting screws inserted in strap.

Quick Identification — Red body cover for easy identification.

Write today on your letterhead for free sample.

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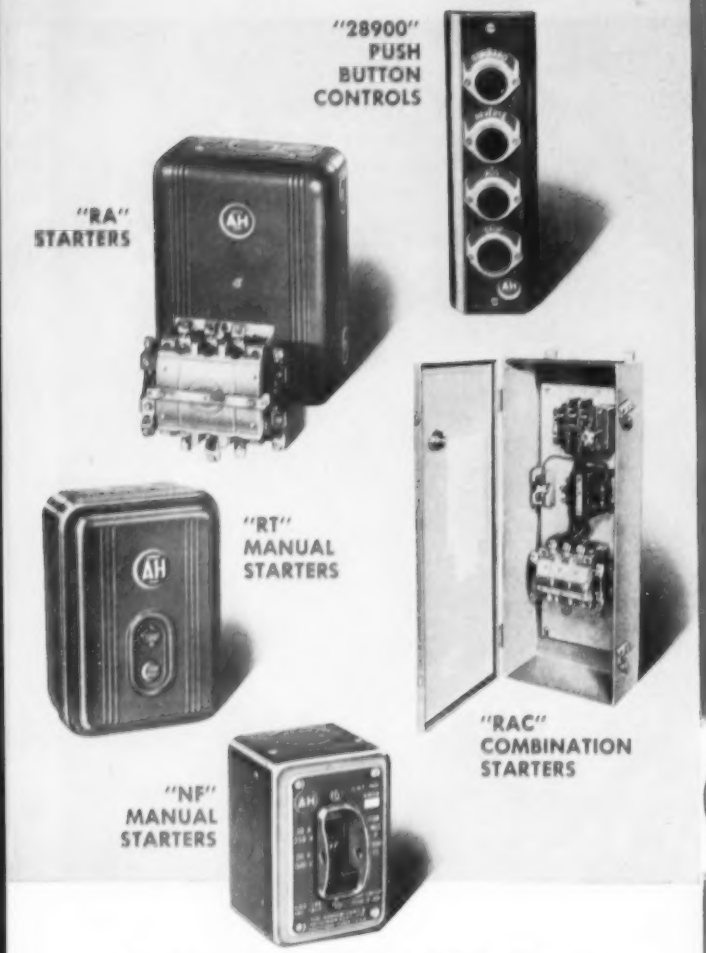

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The motor controls shown above, and all the other products in the *complete* ARROW-HART motor control line, bear a name that has earned a high rating in the electrical industry during the past 67 years. This fine name – ARROW-HART – is your assurance of motor controls you can rely on for quality and dependability.

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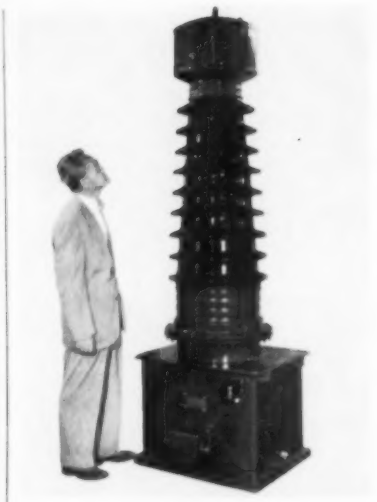
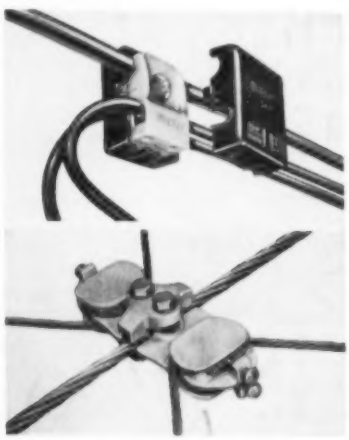
APPLIANCE SWITCHES · WIRING DEVICES



High Voltage Transformer (24)

These type APT high voltage potential transformers which feature reduced size, cost, and weight are available in voltage ratings of 92 to 161 kilovolts. Meeting all ASA standards for high voltage metering and relaying, the units are designed for line-to-neutral operation although their cores are fluxed for line-to-line voltage during emergency. Illustration shows a 115-kv model which measures 100 in. high.

Westinghouse Electric Corp., P. O. Box 2099, *Pittsburgh, Pa.*



Tap Connectors (25)

Cabled secondary distribution lines can now be tapped from mid-span or near the pole with connectors called "Spantaps." One phase unit and one neutral unit connect as many as four triplex services to a cabled secondary. One man can install the neutral, deadening and connecting it electrically in one operation. Services can be added to or

removed from the phase connector without disassembling its insulating cover. Units are electrically stable under adverse mechanical and thermal conditions.

Burndy Corporation, Norwalk, Conn.

Circuit Breakers (26)

New frame-mounted oil circuit breakers for 23, 34.5, 46, and 69 kv services, utilizing drop-bar contact structure, hydraulic operating mechanisms, and simplified mechanical linkage, meet ASA and NEMA standards. The breakers are equipped with standard type O interrupters while contact mechanism is the new type AF of drop-bar design which has a minimum number of parts for simplified adjustment and maintenance. Individual breaker units are lined mechanically by reciprocating pull-rod from the operator through bell-cranks to the drop-bar mechanism. Type OA hydraulic operating mechanisms assures high-speed opening and closing operations. All breakers have 5-cycle opening and 20-cycle reclosing times.

Federal Pacific Electric Co., 5815 Third St., San Francisco 24, Cal.

Louver Lens (27)

Intersecting prismatic elements of clear refractive material formed around truncated pyramidical apertures form a new louver-lens reportedly having an efficiency of 86.1%. Called "Prismoid-Gratelite", the lens provides 45° by 45° lamp shielding as well as good ventilation. These panels are injected molded from either polystyrene or acrylic plastic in 11- by 48-in. or 16- by 48-in. size panels.

Edwin F. Guth Co., 2615 Washington Ave., St. Louis 3, Mo.

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Here's a SOFT TOUCH for Greater Profits . . .

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TAP ACTION SWITCH

For new installations or modernizing, it's easy to build customer satisfaction and bigger profits with this newest touch in lighting control. The Quiette Tap Action Switch – WHICH FITS ANY STANDARD TOGGLE WALL PLATE – turns quietly on *or* off at the tap of a finger-tip, hand or elbow. No toggle to flip, no knob to twist. Safely controls appliances and incandescent or fluorescent lights.

- H&H SPECIFICATION GRADE, UL APPROVED
- 15 AND 20 AMPS, 120-277 VOLTS, AC ONLY
- SCREWLESS TERMINALS OR BINDING SCREWS
- AVAILABLE . . . IN BROWN OR IVORY, SINGLE POLE, DOUBLE POLE, 3-WAY AND 4-WAY.

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APPLIANCE SWITCHES · WIRING DEVICES

"Mounting brackets on Clark-American flush-type Service Entrance equipment cut our installation time over 30%"

"Just position against a stud, drive two nails, and the box is mounted with front surface accurately placed to be flush with finished plaster."

This is one of the many reasons why Clark-American service entrance equipment is the choice of progressive electrical wiring contractors like Thomas A. Haines, owner of the London Road Electric Company, Cleveland, Ohio.

Taking advantage of this feature, and the ample wiring space, many conveniently located and easily removed knockouts in every Clark-American panel, Mr. Haines has been able to cut his installation time substantially on house wiring jobs.

Dependable, trouble and service free Clark-American utility service equipment can be selected from models and sizes to meet any commercial or domestic electric load requirement. Trim, compact units for service up to 200 amperes are available with adequate plug fuse circuits and cartridge pull-outs to meet the requirements of the modern all-electric home.

FEATURES INCLUDE:

- Baked-on grey enamel finish
- One-piece trim and door
- Cover easily removed
- Plenty of knockouts, conveniently located
- Knockouts easily removed
- Generous wiring space
- Slotted upper mounting holes
- Plated solderless connectors suitable for copper or aluminum wire
- Wire-binding screws on plug fuse terminals
- Non-interchangeable pullouts
- Wiring diagram inside door

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ELECTRIC SWITCH DIVISION
The CLARK CONTROLLER *Company*
Everything Under Control • 1146 East 152nd Street • Cleveland 10, Ohio

Time Switches **(28)**

Available in both indoor and outdoor design, these time switches feature a 24-hr dial which can be used for as many as 12 on-off operations in a single day with trippers set as close as one hour apart. Indoor model TSA-47 is designed for flexibility, with both double and single pole contacts available. For use where a heavy duty outdoor case is required, model TSA-41 offers protection against all types of weather. Contact rating is 35 amps tungsten load at 240 volts; operating voltage—120 and 240-volts ac, 60, 50, and 25 cycles per second; temperature limits—from —20° to 150° F.

General Electric Company, Schenectady 5, N. Y.

Extension Cord Reels **(29)**

Two portable cable reels feature wide adaptability and have no current collectors, sliding brushes, or spring contacts. Able to handle any size wire or cable, the reels are of all-welded steel construction. Adjustable steel pins can be inserted to fit any coil diameter, with lock bearings adjustable to any coil width. Model NC-15 measures 15 in. in diameter, handles 150 ft of 12/2 cord; model NC-18 has an 18-in. diameter, handles 250 ft of 12/2 cord.

Hykon Manufacturing Co., P. O. Box 923, Alliance, Ohio.

SORGEL — the Quietest dry-type transformers at standard prices

WE GUARANTEE that the sound levels of ALL Sorgel dry-type transformers are well below the established standards in ALL ratings up to 3000 Kva, and all voltages up to 15,000 volts. This has been an outstanding feature in Sorgel transformers for many years; in fact, we are the **originators** in establishing low sound levels.

OUR MODERN TESTING FACILITIES enable us to prove the low sound level, efficiency, temperature rise, and performance of Sorgel transformers, before installation.

COST LESS TO INSTALL, because they are all self-contained in a single unit — either single phase or 3-phase — equipped with substantial wall brackets or floor mounting base. No separate brackets to make or buy. Easily accessible, roomy connection compartment, with wide choice of knockouts. Solderless terminals.

OTHER INSTALLATION SAVINGS. SORGEL dry-type transformers are so quiet that they can be installed in any convenient place inside of buildings, close to load centers. This results in shorter feeders, better voltage regulation, more efficient distribution, and lower wiring cost.

LIBERAL DESIGN, HIGH EFFICIENCY. SORGEL dry-type transformers are guaranteed to carry their full rated load continuously at high efficiency. They are so liberally designed that they can carry an overload during an emergency at a safe operating temperature. Vacuum impregnated windings brazed to solderless terminals assure years of trouble-free service.

TIME-TESTED. Nearly half a century of transformer development, engineering and manufacturing experience, have been incorporated in the design and construction of Sorgel transformers.

HIGHEST ENDORSEMENT. Sorgel Sound-Rated transformers have earned the highest endorsement of leading engineers and users.

Available in all standard and intermediate ratings. ¼ to 3000 Kva, and from 120 volts to 15,000 volts.

15 to 50 Kva 3-phase. Wall mounting. Connection compartment panel removed

SORGEL TRANSFORMERS

Sales engineers in principal cities.

Consult the classified section of your telephone directory or communicate with our factory.

Substations

The same quiet Sorgel transformers are also incorporated in substations. Procurable with any type or make of switchgear, or from any substation manufacturer.

3-phase versus 3 single phase

Save on installation cost by installing a Sorgel 3-phase unit instead of 3 single phase transformers. Available in 3 Kva to 3000 Kva, and all voltages up to 15,000 volts.

SORGEL ELECTRIC CO., 836 West National Ave., Milwaukee 4, Wisconsin

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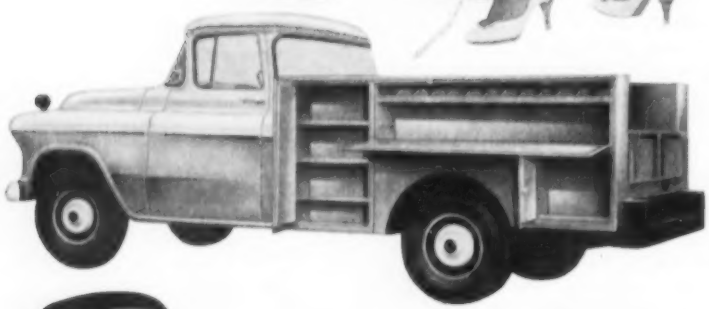

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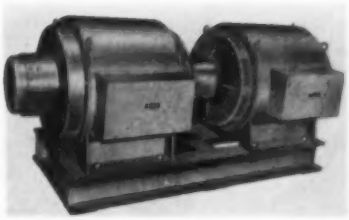


Motor-Generators **(30)**

A new series of both high-voltage motors and high-voltage generators is currently available. Motors are available in ratings of as high as 200 hp, 4160 volts at 1200 rpm. Generators are offered in ratings of up to 300 kw, 4160 volts, 1200 rpm. Illustration shows a 200 hp high voltage motor of two bearing design driving a two bearing, 125 kw, low voltage, 60 cps alternator.

Kato Engineering Co., 1415 *First Ave., Mankato, Minn.*

Transformers **(31)**

A new line of unity power factor mercury lamp transformers for series circuits is designed for use on 10,500-volt circuits or less and is an improved replacement on old style systems.

Jefferson Electric Co., Bellwood, Ill.

Demand Meter **(32)**

A recent addition to a line of printing demand meters is a self contained model with a built-in synchronous motor driven timing mechanism. The PD-57 is intended for use with a watthour meter or a totalizing device to provide a printed record of demand. Contact-operated, the "block-interval" type meter records demand for each time interval on a metered circuit in numbers from 0 to 999. Features of the new meter include: a demand dial pointer which shows at all times the printing counter's stage of advance from the zero position; a maximum demand

pointer showing the maximum advance of the printing counter during any previous interval since the pointer was last reset manually; and a totalizing counter showing directly the number of impulses received from the contact device.

General Electric Company, Schenectady 5, N. Y.

Floodlights **(33)**

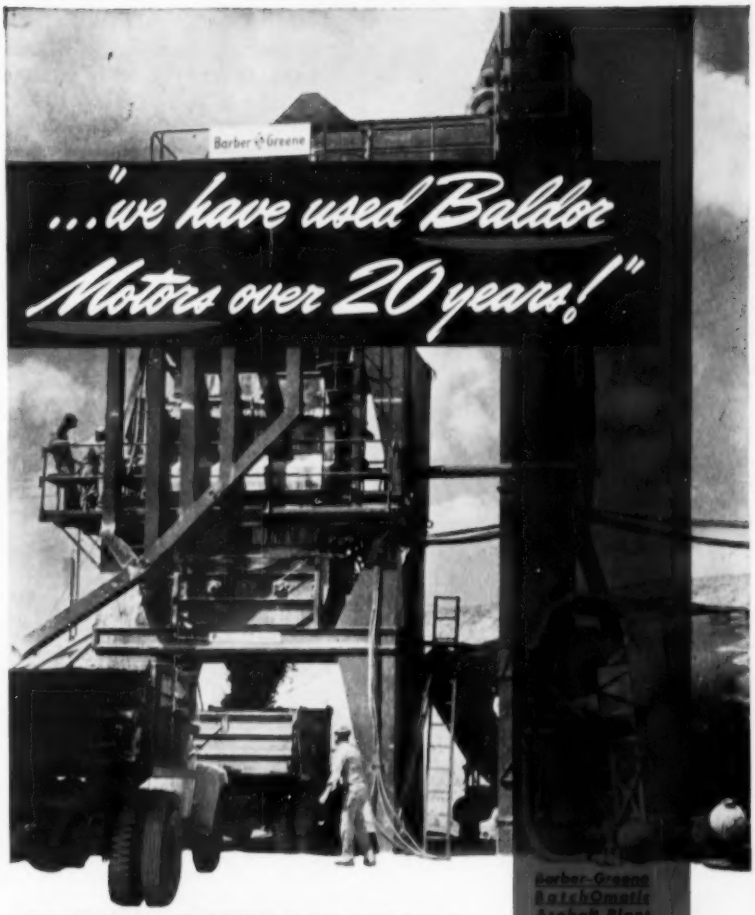
These new floodlights are designed to meet NEMA specification FL-6-210, types 2, 3, 4, and 5. Equipped with cast aluminum neck having built-in cooling fins, Series 4000 units prolong lamp life and efficiency through more rapid heat dissipation. Thermal shock and impact resistant lens is assembled to a stainless steel lens ring attached to the floodlight by steel hinge and spring clips. Sockets will accommodate PS type lamps ranging from 300 to 1500 watts as well as 400-watt mercury vapor lamps. Each unit is equipped with rifle sight and beam sight post for accurate aiming. Other features include repositioning stop, degree marking scales, built-on service wrench and watertight connector. Series 4000 are available with specular or diffuse reflectors for cross-arm, pipe clamp, wall or pole top mounting.

Steber Manufacturing Co., Broadview, Ill.

Photoswitch **(34)**

Reliable and automatic on-off control of any lighting system whose operation is related to outdoor light conditions is accomplished by type 21BJ3 photoelectric light control. A single amplifier tube and associated printed circuitry and components make up the unit whose fuse and sensitivity control can easily be reached without removing the plastic cover. In operation, unit has fail-safe feature.

Electronics Corporation of America, 77 Broadway, Cambridge 42, Mass.


Barber-Greene
...we have used Baldor Motors over 20 years!"
Barber-Greene BatchOmatic Asphalt Plant
Up to 6 Baldor Streamcooled Motors are used to power these gigantic machines

BARBER-GREENE Depends on Baldor Streamcooled Motors to Power Its Asphalt Batch Plants & Belt Conveyors!

Despite the constant torture of dust and dirt, Baldor Streamcooled Motors keep famous Barber-Greene equipment operating at top efficiency, day after day.

Dependable performance under the severest operating conditions is typical of Baldor Motors—just one of many reasons why you can install them with complete confidence . . . the kind of confidence that has been earned among hundreds of satisfied users for over a third of a century.

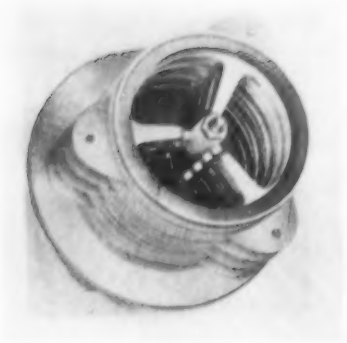
Find out why you get *more* with Baldor —write for FREE color catalog!

BALDOR ELECTRIC COMPANY

4353 Duncan Ave. **St. Louis 10, Missouri**

Over 400 Authorized Sales & Service Distributors in U. S. A.

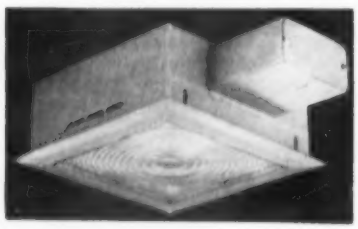
District Offices: Atlanta • Chicago • Cincinnati • Cleveland • Dallas • Des Moines • Detroit • Indianapolis Litchfield, Conn. • Los Angeles • Milwaukee • Minneapolis • New Orleans • New York • N. Kansas City, Mo. Oakland • Philadelphia • Portland, Ore.



Relays (35)

Type RA relays feature contact assemblies sealed in a vacuum and surrounded by a stacked ceramic enclosure. For severe environmental conditions where small size and reliability are of importance, these relays operate satisfactorily during vibration of 25G from 10 to 2000 cps, during 50G shock, and at ambient temperatures of 200° C. RA series will switch low level "dry circuits" in the millivolt-microampere range or handle inductive loads with peak inrush currents of 60 amps. Interrupting ratings are 15 amps or more. Three contacts in parallel are used in each switching circuit to insure reliability and high current ratings.

Jennings Radio Manufacturing Corp., P. O. Box 1278, San Jose, Calif.



Recessed Fixtures (36)

Square 60-watt recessed fixtures are available in three styles: unwired, unwired with asbestos lining, and completely prewired. Frames can be equipped with any of six separate lenses and easy maintenance is assured by frame attachments which can be quickly opened without tools. Available in a choice of chrome, copper, or brass plating; white or grey paint; and satin aluminum anodized or satin black anodized finish. All units are equipped with fibre glass gaskets to seal out light leakage.

Atlas Electric Products Company, 319 Ten Eyck St., Brooklyn 6, N. Y.

Subfeed Lug Kit (37)

A new sub-feed lug kit makes it possible to add sub-feeds to standard NQO circuit breaker lighting panelboards. Available for both 100-amp and 200-amp main lug panelboards, the kit includes all necessary parts to allow simple conversion of a standard panelboard. Together with a 3-pole QO breaker, the kit allows a good number of panelboard problems to be solved from local distributor stocks.

Square D Company, 6060 Rivard St., Detroit 11, Mich.

Watertight Buzzer (38)

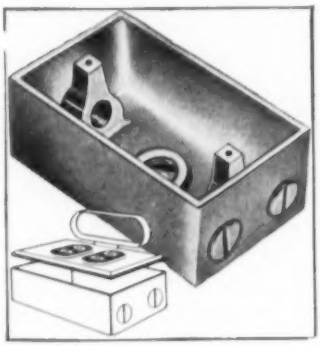
A new line of watertight buzzers designed for operation under severe conditions of exposure to the elements are normally manufactured as totally sealed enclosed units although they can also be supplied as hermetically sealed devices. Contact type mechanisms are available for voltages from 6 volts to 48 volts ac or dc while a contactless mechanism can be obtained in a voltage range of 8 volts to 48 volts. Measuring 3¼ in. long, 2¼ in. wide, and 1⅞ in. high with external solder type terminals, the buzzer is totally enclosed.

Auth Electric Company, 34-20 Forty-fifth St., Long Island City 1, N. Y.

Pushbuttons (39)

Series "BA" standard duty pushbuttons provide an economical pilot control for magnetic controls and solenoids of magnetically operated devices. Furnished with normally open contacts, normally closed contacts, or a combination of these two, controls are available in either two or three pushbutton units. A base mounted control mechanism and front accessible wiring terminals as well as a reversible formed steel base and wrap around cover of molded alkyd are features of these control stations. Available in the following ac ratings: 3 amps, 110 volts; 1.5 amps, 220 volts; 0.75 amp, 440-480 volts; and 0.6 amp, 550-600 volts. Dc ratings are: 1.1 amps, 115 volts; 0.55 amp, 230 volts; and 0.2 amp, 550-600 volts.

Furnas Electric Company, 1000 Mckee St., Batavia, Ill.



Outdoor Enclosures (40)

A new line of cast aluminum outdoor boxes and weatherproof box and cover combinations for use with receptacles and switches has recently been announced. Outdoor boxes are made of cast aluminum and sized to house all types of weatherproof outlets. Available in two styles—with three ½ in. diameter threaded openings with reinforced internal hubs or with four ½ in. diameter threaded openings. Line of weatherproof box and cover combination features snap covers, flush screw covers, and flush switch and box models. These meet NEC requirements for use with portable electric tools, lawn mowers, outdoor lighting, etc. Combination box and covers are available with single or duplex receptacles, parallel slots, or 3-wire grounding. All combination units have weatherproof mats and mounting screws.

Bell Electric Company, 5735 S. Claremont Ave., Chicago 36, Ill.

CROUSE HINDS

"SPOTLIGHT ON LIGHTING"

HANDY GUIDE TO
Special Purpose Lighting

- EXPLOSION-PROOF
- DUST-TIGHT
- VAPORTIGHT
- FLOODLIGHTING
- UNDERWATER

and Other Special Applications

LIGHTING "SPOTLIGHT ON LIGHTING" -- CROUSE-HINDS HANDY GUIDE TO C

Type EV Explosion-Proof Lighting Fixtures in a painting department.

Type EVA Lighting Fixture with dome reflector

• Easiest Installation
• Easiest Maintenance
• Highest Efficiency!

EVA

Explosion-Proof Lighting Fixtures for Hydrogen and Acetylene areas

A full line of lighting fixtures and hangers, switches, junctions, seals, unions, flexible couplings, etc., is available from Crouse-Hinds for complete lighting installations in *all* Class I areas. Gas tightness is not a requirement for safe operation of EVA. Relamp right in the gas-laden atmosphere. Sizes: 150W to 300W.

National Electrical Code: Class I, Groups A, B, C & D

You get all three with famous "EV Series" Explosion-Proof Lighting Fixtures!

These three features – *quickest installation, quickest relamping, more light* – have made the EV Series the most popular explosion-proof lighting fixtures ever developed! Designed in accordance with UL requirements, they are approved for every Class I location listed as hazardous in the National Electrical Code. You can get one to fit your needs exactly: pendent, ceiling, bracket or bulkhead – in a wide variety of reflector shapes. Sizes 75W to 500W. Special features available: polished finish, breathers, frosted globes.

EVA Series Pendent Type

EVCX Series Ceiling Type

EVJ Series Bulkhead Type

EVBX Series Bracket Type

EVA Series with prismatic Holophane Reflector

CROUSE-HINDS

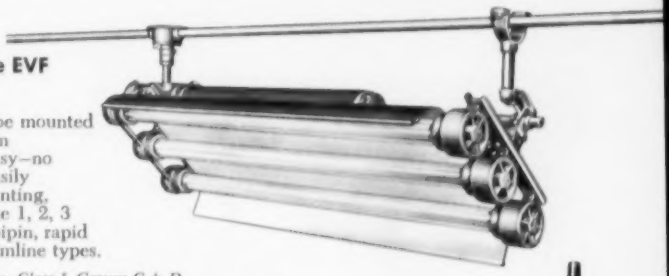
EXPLOSION-PROOF LIGHTING FIXTURES

Crouse-Hinds explosion-proof lighting fixtures feature many important benefits: a broad selection, wide enough so you can get approved fixtures of the type you want for *any* hazardous area. Up-to-date, safe, UL-listed designs. The latest improvements in convenience and efficiency.

Only a sampling of Crouse-Hinds explosion-proof lighting fixtures is shown here. See catalog offer at bottom of page for more information.

There's a Crouse-Hinds Explosion-Proof Lighting Fixture for Your Special Application . . .

The group below illustrates the broad range of special-purpose lighting fixtures available for use in many specific industries. A Crouse-Hinds Field Engineer can help you solve explosion-proof lighting problems.



For Fluorescent Installations, Type EVF Explosion-Proof Lighting Fixture

Installation is unusually simple. Can be mounted end to end to provide continuous, uniform illumination. Relamping is quick and easy—no special tools needed. Ballast housing easily accessible. Available with pendent mounting, straight or at 45°. Sizes and styles to take 1, 2, 3 or 4 lamps, 40W to 100W conventional bipin, rapid start bipin and instant start single-pin slimline types. Also dust-tight.

National Electrical Code: Class I, Groups C & D
Class II, Groups E, F & G

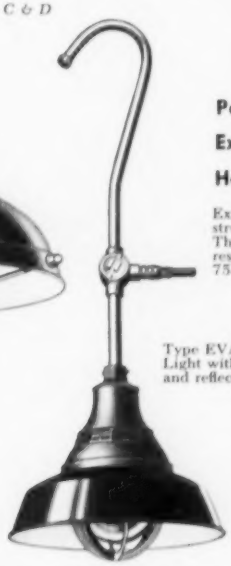
Type RCDE-8 for flush ceiling mounting.

Type RCDE-8 Explosion-Proof Lighting Fixtures*

Especially suited to railroad repair pits as well as floodlighting applications—or for flush mountings in suspended or poured ceilings. Available with various style reflectors and lenses. For 100W to 200W lamps.

Type RCDE-8 with suspension base.

Type EVPH Pedestal Light for outdoor illumination. *



Type EVA Cargo Light with guard and reflector. *

Portable Explosion-Proof Hand Lamp

Explosion-proof construction throughout. Thick, impact-resistant globe. 75 or 100W. †

Type BKL10 Brew Kettle Light. To be attached directly to tank. *

Type EVO Tank Light for suspension over tank port holes. *

Send for Catalog Our complete line of lighting equipment is described in this catalog. It's free. You'll find it a helpful guide in your work.

CROUSE-HINDS

* *National Electrical Code: Class I, Group D.*
† *National Electrical Code: Class I, Groups C & D*

Type DLA Dust-Tight Lighting Fixtures installed in a grain elevator.

Type DLA Dust-Tight Lighting Fixtures installed in an ammonium nitrate plant.

For Complete Safety In Any Dust-Laden Atmosphere

DL Series DUST-TIGHT* Lighting Fixtures

Crouse-Hinds Dust-Tight Incandescent Lighting Fixtures are designed to exclude dust from the fixture interior, minimize the accumulation of dust on the fixture exterior, and to operate at temperatures below the ignition point of dust. In addition, they are easily installed, attractive in appearance, and available in a wide range of types and sizes from 100W to 500W.

*Dust-ignition-proof

For Applications Not Requiring Intense Illumination

Type DLA with guard

Crouse-Hinds fixtures such as Type DLA shown below are recommended for dust-laden locations in which light of high intensity is not essential. While they are lower in cost, they contain all the safety features of the DL Series fixtures at right.

National Electrical Code: Class II, Groups E, F & G

For Applications Where Intense Illumination Is of Prime Importance

These DL fixtures feature an inner reflector and are available with a wide variety of outer lens reflector styles. All are designed to produce a high degree of light intensity. The selection shown is but a fraction of the many mounting types obtainable.

DLB Series, Bracket Type

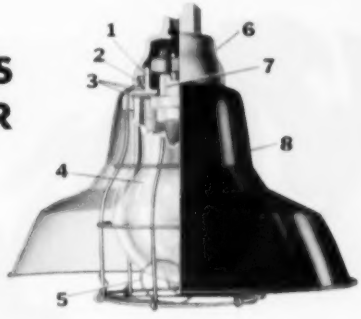
CROUSE-HINDS

Vaportight Lighting Fixtures

Crouse-Hinds Vaportight Lighting Fixtures protect lamp, receptacle and wiring from moisture, gases, vapors, smoke, lint, non-hazardous dust conditions, etc. They are designed for use in exposed, damp or dirty locations such as docks, paper mills, breweries, boiler rooms, roundhouses, dairy plants and marine applications.

New! CROUSE-HINDS VAPORMASTER Lighting Fixtures

Cut relamping costs in half! Adapt for larger lamp size without rewiring! Cleaning and relamping is done in only half the time – *without tools!* A simple change of adapters accommodates a larger lamp – *without touching the wiring.*



1. Aluminum adapter-guard assembly fits all Condulet bodies. 2. Stainless steel retaining spring holds reflector. 3. Gaskets make vaportight seal between globe and adapter, reflector and body, adapter and reflector. 4. Pear-shaped globe – lamp cannot strike side of globe. 5. Globe clamping spring – opens for relamping. 6. Condulet body equipped with receptacle base has set screw in hub to lock on conduit. 7. Shock-absorbing receptacle has universal action – absorbs shock from *any* direction. 8. Porcelain enameled steel reflector.

Vapormaster relamping is amazingly quick and easy.

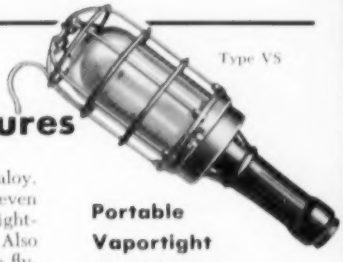
V and VH Series VAPORTIGHT Lighting Fixtures

Type VDA Screw Guard Style

Type VDA Clamp Guard Style

Constructed of tough, corrosion-resistant cast Feraloy. Simple in design: wiring chamber remains vaportight, even if globe is broken or removed. Use them to protect your lighting in any wet or corrosive locations. Also suitable for Class III locations (ignitable flyings and fibers). Available with clamp or screw guards, in 11 hub arrangements. Pendent, bracket or ceiling styles. Sizes: 50W through 500W.

Type VDB with Deep Bowl Reflector



Type VS

Portable Vaportight Hand Lamp

Handle and globe holder are one-piece moulded Neoprene. Completely vaportight. Sizes for 75W and 100W lamps.

DLA Series with Threaded Reflector and Lens Assembly For lamps up to 500W

Type VUB Vaportight Decorative Fixture

C Series, Ceiling Type, with flat cone reflector.

Send for your copy of abridged Catalog # 3400

CROUSE-HINDS

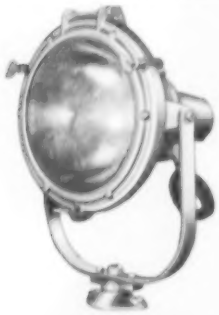
FLOODLIGHTING

From major athletic fields to parking lots, from petroleum refineries to boxing rings, modern Crouse-Hinds Floodlighting turns night into day. With a type and style floodlight to suit every need, Crouse-Hinds will help you put exactly the right amount of light in exactly the right places.

Our Lighting Engineers have the broadest experience in Floodlighting. You can get their assistance by sending a drawing and description of the area you plan to light. We will then submit a complete lighting recommendation, with prices, for your consideration.

Mercury Vapor Floodlights

The light output of mercury lamps is more than twice that of large incandescent lamps, and the rated life is seven times as long. The cost of mercury lamps is justified when important factors are long burning hours, labor costs or trouble of relamping. Constant-wattage-type ballasts regulate the lamp current so that light output remains constant even with large variations in line voltage. High-power-factor ballasts are generally preferred since the lower line current may allow a saving in the wiring cost. Crouse-Hinds broad Mercury Vapor line will meet virtually any floodlighting requirement.



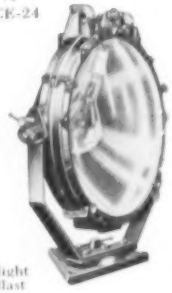
Type MVE
Heavy Duty
Mercury Floodlight

Type MVB
General Purpose
Mercury Floodlight

Type MVF Floodlight and Pipe Top Ballast Mounting

Type ADE-12

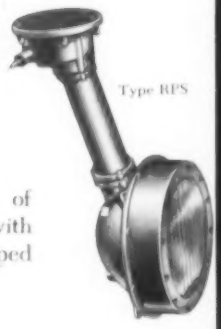
Type LCE-24



Heavy Duty Floodlights

Constructed of cast aluminum alloy to withstand rough, rugged duty. They are highly efficient and are available in 12", 14", 16", 20" and 24" lens diameters, from 200W to 2000W lamp sizes. Reflectors and lenses can be varied to provide narrow or wide beams, diffused, concentrated or colored light – or any other combination needed.

Type SPS



Type RPS

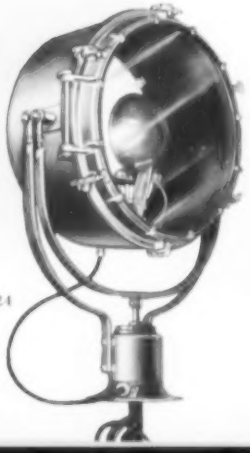
Floodlights for Underwater Use

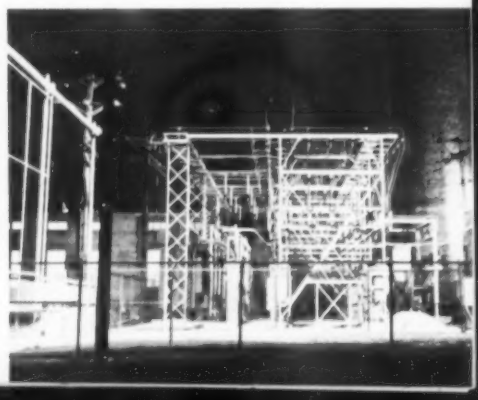
Crouse-Hinds Underwater Floodlights are of the dry niche type. Both styles are available with or without tile masks. Type RPS can be relamped from pool edge.

Incandescent Searchlights

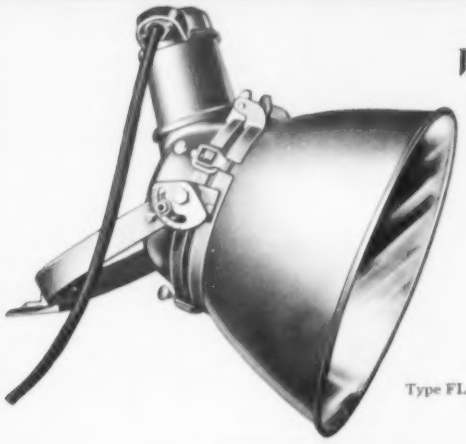
Crouse-Hinds searchlights in 8, 12, 18, 24 and 36-inch lens sizes and lamp sizes to 5000 watts are available with several different types of bases. Type DCE searchlights are generally used as fixed projectors for spotting distant objects; Type DCY are arranged for direct manual control; and Type DCX are furnished with lever control base for directing from below.

Type DCX-24





CROUSE-HINDS



Type FLA

Widely acknowledged as the finest.

TYPE FLA FLOODLIGHT

Especially suited to sportslighting

Easier to install, aim, maintain, relamp. Higher efficiency. Permanently weathertight. Pre-wired. Corrosion-resistant. Heat-tempered lens. Available in five beam spreads. Non-tarnishing Alzak reflectors. These are some of the reasons why the FLA is the most popular Floodlight available anywhere. Type FLA has found special favor in sportslighting. Gives more light at lower cost with less maintenance for a longer period. You name the sport and FLA will light it . . . *better*. Lamp sizes 750W to 1500W. Ask for Sportslighting bulletin 2605.

Type MUA Alumalux (750W–1500W)

Type MDB-14 (500W)

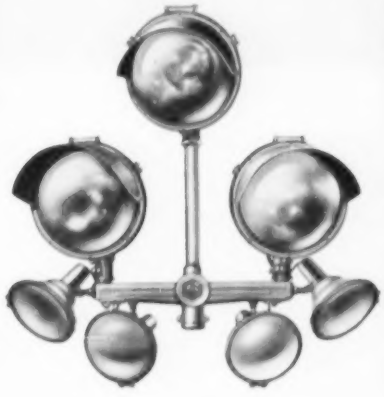
Type MDB-10 (300W)

e MUA Elliptalux 750W–1500W)

General Purpose Floodlights

Available in an amazing variety of sizes, types and prices. There are simple porcelain-enameled open styles, low-cost sheet aluminum styles, lightweight weather-proof hinged-door styles . . . and so on. Get exactly what you want from the many types of reflectors, mountings, lenses and beam spreads offered.

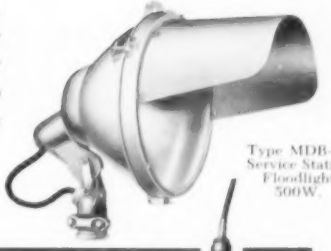
New. Type SFL Sign Lighting Floodlight.



A typical installation of MDB-14 and MDB-10 Floodlights on a GPT Crossarm.

For Modern Service Station Lighting

Crouse-Hinds offers several floodlights especially designed for service station use. No matter what the lighting problem – driveways, signs or buildings – you'll find Crouse-Hinds equipment to do the job. The details, plus lighting diagrams, are in Bulletin 2689. Write for a copy.



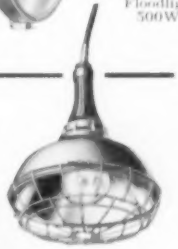
Type MDB-14 Service Station Floodlight 500W.

ype RCDER-6 xplosion-Proof table Floodlight. so available for permanent installation CDE-6). 300W.

Type RLEE Explosion-Proof Floodlight. For heavier-duty applications. 500W.

Type ADR Portable Floodlight. Especially adapted to emergency portable use. 250W to 1000W.

Type MDS High Bay Lighting Fixture. Widely used for tennis courts, gymnasiums and arenas. 500W to 1500W.



Type DIV Portable Underwater Floodlight. 100W–250W.

Literature Available

We will send you catalog information on any Crouse-Hinds Floodlights. Simply tell us which type interests you.

CROUSE-HINDS

CROUSE-HINDS

the most complete line of Special Purpose Lighting

The preceding pages have covered only a part of the wide selection of Crouse-Hinds special-purpose lighting. From the complete line you can fill nearly every special lighting need — even including such unusual items as Explosion-Proof X-ray Film Illuminators or Explosion-Proof Exit Signs. No matter what your lighting problem, chances are you can find the solution in Crouse-Hinds' lighting line.

A typical Crouse-Hinds decorative display floodlighting installation at the Royal Bank Building, Montreal, Canada.

Type FS
For steps, walks, gardens, etc.

Type FCB-12
For marking obstructions.

Type PLB
For fences and other areas requiring extremely wide beam.

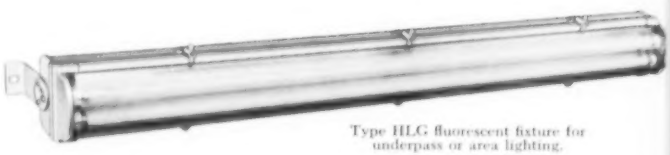
Let Us Help With Your LIGHTING PROBLEM

Crouse-Hinds long experience in special-purpose lighting is available to you without charge or obligation. See your Crouse-Hinds distributor. Or contact the nearest Crouse-Hinds office.

Either way, you'll get the information you need, not only on lighting fixtures, but also on the 15,000 switches, plugs and receptacles, motor controls, junctions, conduit fittings, etc., which make up the complete Crouse-Hinds Condulet® line. *A complete Condulet catalog is yours for the asking.*

Type GCP-14
Ornamental floodlights.

Type RCD-8
Flush Mounting in concrete walls or floors.



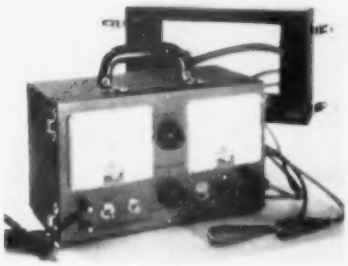
Type HLG fluorescent fixture for underpass or area lighting.

CROUSE HINDS

MAIN OFFICE AND FACTORY: SYRACUSE, NEW YORK
Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

• CONDULET® ELECTRICAL EQUIPMENT (Explosion-Proof and Conventional) • FLOODLIGHTING
• TRAFFIC CONTROL SYSTEMS • AIRPORT LIGHTING and WEATHER MEASURING EQUIPMENT

C H products are sold exclusively through electrical distributors. For application engineering help, contact one of the following offices: Baton Rouge Birmingham Boston Buffalo Chicago Cincinnati Cleveland Corpus Christi Dallas Denver Detroit Houston Indianapolis Kansas City Los Angeles Milwaukee New Orleans New York Philadelphia Pittsburgh Portland, Ore. Salt Lake City St. Louis St. Paul San Francisco Seattle Tulsa Washington **Resident Representatives:** Albany Atlanta Baltimore Charlotte Chattanooga Jacksonville Reading, Pa. Richmond, Va. Shreveport



Insulation Tester (41)

Lightweight portable electrical insulation tester checks insulation of products for resistance, power factor, and breakdown strength. Useful in the engineering lab, in field testing, and in maintenance service, these testers feature a sensitive voltmeter, a dual-range leakage microammeter, compensator for cancelling capacity effects, continuously variable testing voltage, and limited current output for safety. Model 122 has a test voltage range to 2100 volts ac with a 0/100/1000 microamp leakage meter giving the instrument an overall useful range of about 200 megohms ac insulation resistance. Model 125 is a dc unit providing an effective range to more than 500 megohms dc insulation resistance. Both models are available in other ranges to 10,000 volts.

Slaughter Company, Young & College Sts., Piqua, Ohio.

Conduit and Tubing (42)

To an existing line of carbon steel conduit and metallic tubing has been added similar products made of "Yoloy" steel. These latter types of conduit and electrical metallic tubing have been designed for use in places where corrosion is more severe than normal.

Youngstown Sheet and Tube Company, Youngstown 1, Ohio.

Illuminated Ceiling (43)

"Paragrid-Tile" is an illuminated ceiling molded of light-stabilized pigmented polystyrene available in modular size of 16 by 16 in. with louver construction and ½ by ½ in. apertures. Featuring easy installation on simplified channels, this illuminated ceiling may be incorporated in any lighting installation, overall ceilings, troffers, industrial or commercial fixtures.

J. A. Wilson Lighting and Display Inc., 516-517 G. Daniel Baldwin Bldg., Erie, Pa.

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THE SWITCH IS ON
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* NO GROOVES TO CATCH DUST
* LARGER HEAD SCREWS FOR QUICKER WIRING
* STURDIER BAKELITE BODY FOR HEAVIER WIRING
* 7/8" LONG MOUNTING SCREWS ATTACHED TO STRAP

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Cat. No. 733V—Ivory Duplex Receptacle
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Cat. No. 736V—Ivory Duplex Receptacle-with Ears
Cat. No. 736B—Brown Duplex Receptacle-with Ears

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IT PAYS TO MAKE GOOD CONNECTIONS
HUBBELL
the first and only
GROUNDING
Twist-Lock®
3-WIRE, 15 AMP. 125 VOLT
Here is the "Twist-Lock" equivalent of the 5262 Line of Straight Blade Grounding Devices.
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15 AMPS
125 VOLTS
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A COMPLETE NEW LINE . . .
NON-INTERCHANGEABLE
WITH REGULAR "TWIST-LOCK"
NOTE THE SPECIAL ELBOW-SHAPED GROUNDING SLOT.
These new 4700 Series Grounded "Twist-Lock" units are polarized to prevent interchange with regular 125-volt "Twist-Lock" devices. An elbow-shaped grounding slot prevents insertion of regular "Twist-Lock" caps, accepting 4700 Series caps only. With 4700 Series "Twist-Lock" units there is absolutely no danger of plugging into a 3-phase circuit by accident.
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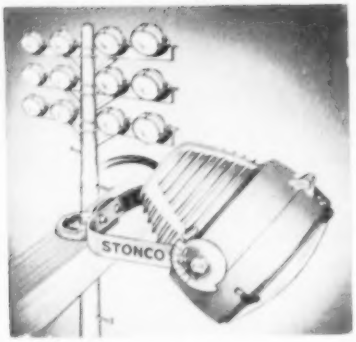
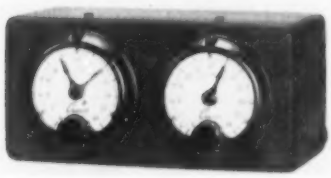
Los Angeles 12, California 103 North Santa Fe Avenue
San Francisco, California 1675 Hudson Avenue
Dallas 7, Texas 1111 Dragon Street



Floodlight **(44)**

Designed for long-throw coverage of wide field areas, a new high powered floodlight named the Powerbeam Sportslighter is particularly suited for lighting of ball fields, driving ranges, stadiums, and other open field areas. Unit uses a 500-watt Powerbeam projector bulb sealed inside a heavy duty cast aluminum housing with a heavy plated steel trunion bracket that allows the unit to be "swung over" for easy handling from the rear. Degree-marked vertical and horizontal aiming quadrants permit pre-focusing on the ground during daylight hours, while a repositioning stop automatically resets unit after servicing.

Stonco Electric Products Co., 333 Monroe Ave., Kenilworth, N. J.



Duplex Timer **(45)**

This duplex cycling timer utilizing two standard motor driven automatic reset timers can control the operation of process equipment, regulate both idle and operating time on a wide variety of production machinery, or perform a large number of in-plant functions automatically. After an initial starting circuit is closed, each timer operates in turn, providing a time interval or delay, restarting the other at the conclusion of each timed period, and then resetting instantly to prepare for its next cycle. Load switches are operated within a repeat accuracy of 1% of full scale reading and are rated at 15 amps, 125 volts, non-inductive.

Cramer Controls Corp., Centerbrook, Conn.

Electric Heaters (46)

Manufactured in six models ranging from 30,717 to 81,912 in Btu output, these heating units are also designed for use with summer air conditioning. In addition to being unitized for easy servicing, they are able to handle either horizontal or vertical air flow.

Muncie Gear Works, Inc., Muncie, Ind.

Raceway (47)

Lightweight, durable, and resistant to warp and sag under high temperatures, this reinforced phenolic plastic channel wiring raceway is completely uncombustible. When subjected to direct flame, the raceway immediately self-extinguishes without after-glow when the flame is removed. All sizes and styles are available.

Stahlin Brothers, 304 Maple St., Belding, Mich.

Underground Feeder Cable (48)

Underground feeder cable is available in all sizes up to and including 4/0. New sizes 2 to 4/0 are in single conductors only. Listed by Underwriter's Laboratories, the cables can be used on 600-volt lines for current values up to 195 amps for direct burial in earth if provided with suitable overcurrent protection.

Columbia Cable and Electric Corp., 255 Chestnut St., Brooklyn 8, New York.

Time Meter (49)

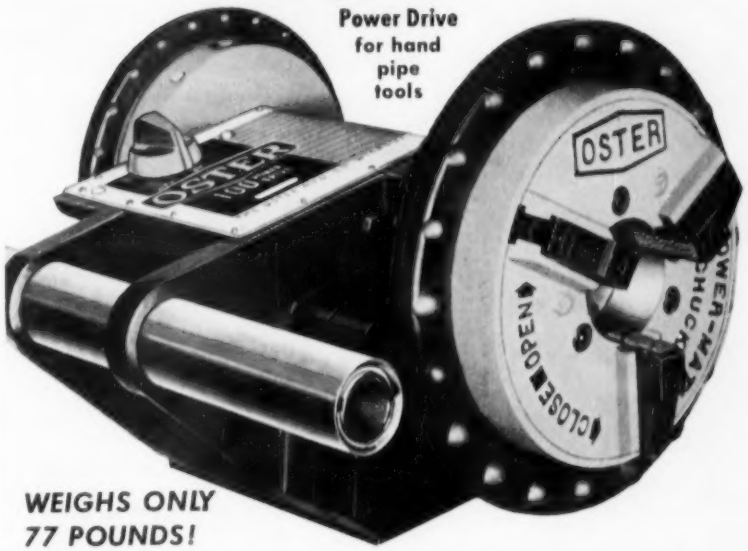
Use of an automobile odometer is a major factor in improved readability of a new line of time meters. Larger digits are placed closer to the front of the meter on the new type KT models. Measuring down to one-tenth of an hour, the meters may be used in connection with maintenance programs in a wide variety of applications. Square or round cases are available in 2½ or 3½ in. sizes for mounting on panels or test equipment. New line includes a sealed model for military use, and a model available in a protective conduit case with die cast zinc base and clamp-on glass cover for mounting outdoors or where there is heavy dust. All models measure either hour and tenths or minutes and tenths. Ratings include 120, 240, or 480 volts at 60 or 50 cycles per second.

General Electric Company, Schenectady 5, N. Y.

NEW Pipe Machine!

OSTER "100"

Power Drive for hand pipe tools



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First time anywhere . . . a rugged, full-duty power drive—Oster quality throughout—with new "POWER-MATIC" front chuck and self-centering rear chuck . . . at the LOWEST price on the market! Get the complete facts . . . mail coupon *today!*

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Please rush me full details on the *new* Model 100 Power Drive.

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ALUMINUM
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SUPPORT SYSTEMS
FOR POWER AND CONTROL CABLES
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AVAILABLE THROUGH LEADING CABLE MANUFACTURERS

HUSKY PRODUCTS, INC.
5300 VINE STREET, CINCINNATI 17, OHIO

Transformers **(50)**

Two lines of dry-type distribution transformers have been extended to include lower ratings with decreased weight and size. Three-phase DT-3 model is now available in a 30 kva rating, extending the line from 30 to 300 kva, in either 600- or 2400-volt classes. This new model is 22% smaller and 20% lighter than the previous similarly rated design. Single-phase DS-3 model line now includes a low rating of 15 kva with size reduced by 15%, weight by 20%. Characteristics of the units are the same as those already in use at larger ratings, featuring mechanically isolated core and coils for quiet operation.

Westinghouse Electric Corporation, P. O. Box 2099, Pittsburgh 30, Pa.

Troffers **(51)**

"Versatile-GRID" recessed troffers provide versatility of size, closure, and lighting level for stores, offices, schools, and public buildings using exposed "T" furring or Acousti-Line ceilings. Available in 1- by 4-ft, 2- by 4-ft, and 2- by 2-ft, these troffers are shallow and can be easily installed in plenums only 8 in. deep.

The Miller Co., Meriden, Conn.

Connectors **(52)**

New color-coded, pre-insulated, spring type wire connectors make possible more than 400 wire combinations using only three connector sizes. Named "Scotchlock", the three connectors have designations "Y", "B", and "R" denoting three sizes which will accommodate AWG wire sizes from Nos. 6 to 18. Three-color coding facilitates selection. Connectors consist of a cone shaped coil spring within a steel shell to prevent crushing in crowded junction boxes. Vinyl insulating jacket molded over the unit features a triangular cross section for a better finger grip during application.

Minnesota Mining and Manufacturing Co., 900 Bush St., St. Paul 6, Minn.

Heating and Cooling System (53)

Year-around conditioning of air in occupied premises is achieved by this system which uses no furnace, chimney, or ducts. Comprised of individual room units connected to a common water supply, the system

cools or heats automatically depending upon ambient temperatures. Each unit is provided with a heat pump devoid of moving parts and a centrifugal fan with variable speed control. Maximum heating capacity of a single unit is rated at up to 11,400 Btu per hour at 175 cfm with entering air at 70°F and circulation of 2 gals per minute of 180°F water through the system. When cooling, each unit extracts 4800 Btu per hour with air movement at 175 cfm and circulation of 2 gals per minute of 40°F water through cooling coils. Units are available in 115- or 230-volt ac models.

Electric Heating and Cooling, Inc., 890-898 Broadway, Newark 4, N. J.

Fittings (54)

A new floor-level fitting for low and high tension service is designed to serve equipment having minimum floor clearances or receptacle outlets used in exposed areas. Fitting for high tension service accommodates several types of receptacles, including a single 3-wire receptacle with a grounded U-slot. Low tension fitting is furnished with a bushed hole in the bell cap. Consisting of a housing, flange and bell cap with a receptacle and insulator furnished on fittings for high tension service, units can be threaded into 1.9-in. I.D. inserts or can be threaded, using an adapter, into 2-in. IPS and 2.5-in. I.D. inserts. When installed, the fitting is 1 in. high.

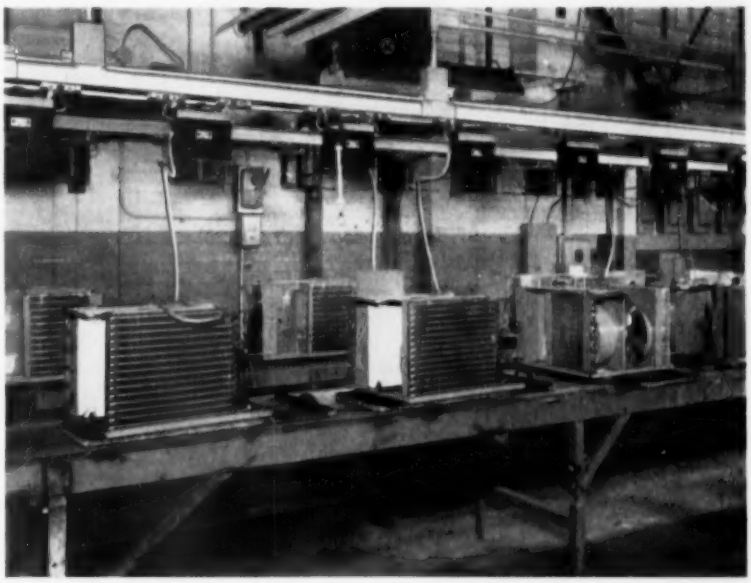
Walker Brothers, Conshohocken, Pa.

Fans (55)

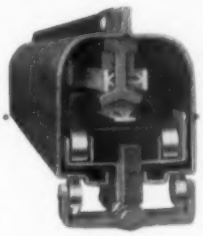
New "LS" direct-driven fans designed for better performance in low static pressure ranges employ 4-blade "Macheta" airfoil propellers and are available in ring, square panel, and duct types, in sizes from 24 in. to 48 in. in diameter. Ring and panel types are designed with curved orifice rings to provide a uniform flow of air to the propeller blades. Panel type is easily installed in any square opening with four corner bolts. Duct type is used in standard application duct sections, with entire unit inside of air stream. All types are available optionally with special-duty motors, alloy propellers, and protective coatings for unusual moisture, temperature, or corrosive conditions.

Aerovent Fan Company, Piqua 19, Ohio.

Get rid of test line "CABLE CLUTTER"



...with a FEEDRAIL "moving power system"



Feedrail systems (60 to 500 amperes) keep production moving throughout industry — provide convenient movable power sources for:

- Cranes and Hoists
- Production Lines
- Conveyor Assembly Lines
- Moving Test Lines
- Portable Tools
- Machine Tools
- Cutting and Sewing Rooms
- Lighting
- Motor Control
- Business Machines

Now you can put your test line operations on a truly modern, automatic basis — by getting rid of unsightly, dangerous, time-consuming "cable clutter."

With a Feedrail "moving power system" you deliver power *from above*. Easy-moving trolley outlets on an overhead steel-enclosed electrified track take off power and provide a *continuous flow of current* to equipment being tested.

This allows work to move smoothly from station to station without a hitch. You save time and trouble; keep hazardous cables off the floor or conveyor line; allow personnel to move about freely and safely.

A Feedrail system can be set up to meet any test requirement or work flow. It never will be obsolete — if production requirements change, Feedrail can be relocated or extended with surprising ease and speed.

For complete information write today to Dept. C-10.

SOLD BY MORE THAN 1,000 ELECTRICAL DISTRIBUTORS FROM COAST TO COAST

17

ELECTRIC FEEDRAIL

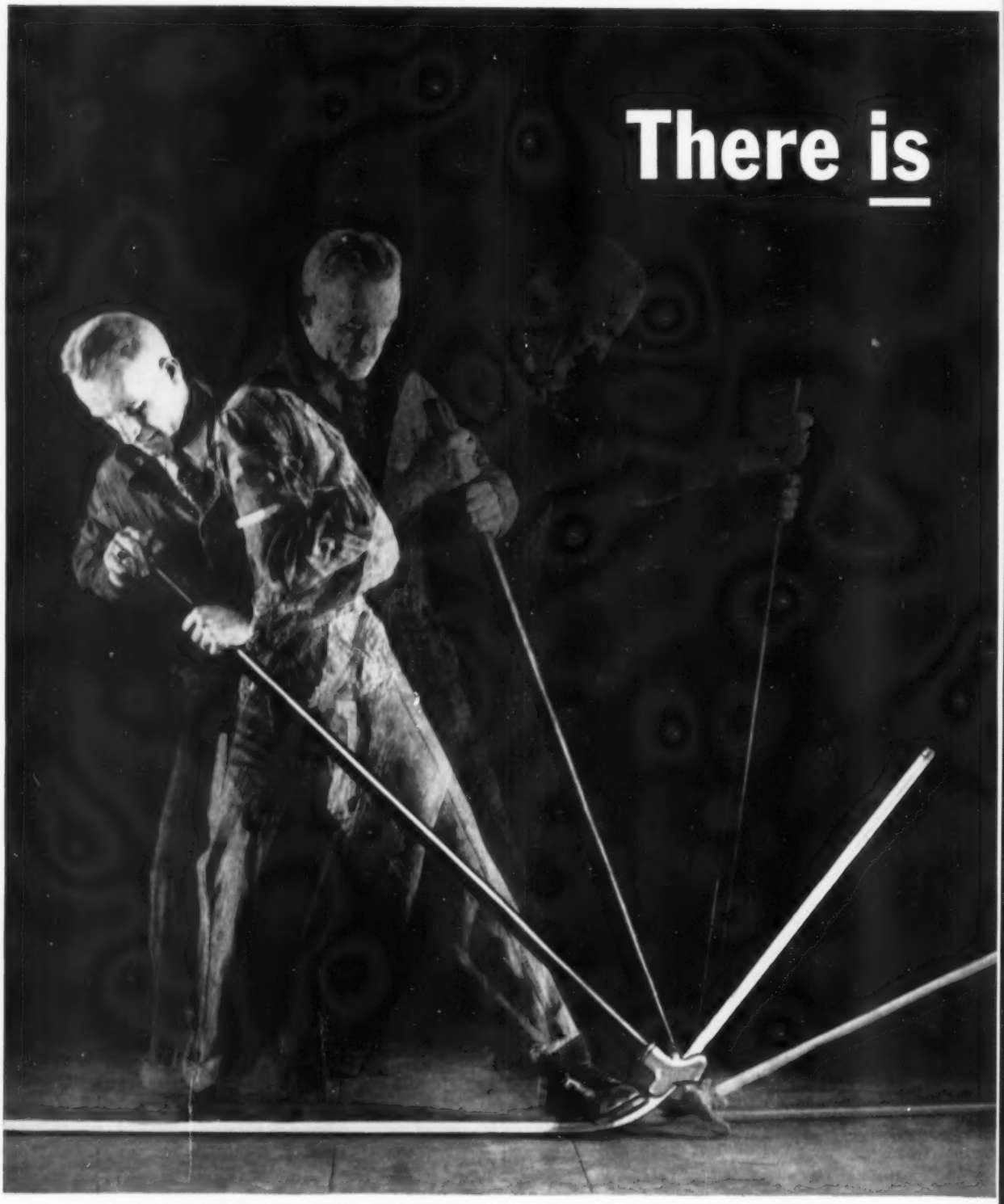
Never Becomes Obsolete

FEEDRAIL CORPORATION

Subsidiary of Russell & Stoll Company, Inc.

125 BARCLAY STREET • NEW YORK 7, N. Y.

SPECIALLY QUALIFIED REPRESENTATIVES IN PRINCIPAL CITIES



G-E WHITE bends smoothly and easily, enabling you to speed up installations and make them more profitable. The metallizing process eliminates conditions that contribute to kinking and flattening.

a difference in conduit

. . . and easier bending is just one of the reasons why G-E WHITE can make your jobs more profitable

There's good reason why G-E WHITE rigid conduit bends easier . . . bends *right* without kinking, flattening or splitting. The secret is in General Electric's unique process of applying zinc coatings to rigid conduit. With this process, metallizing guns blast zinc onto the surface—ensuring a tight, corrosion-resistant coating. Since zinc metallizing does not overheat the conduit, there's no need for the quenching and straightening which tend to work-harden conduit galvanized by ordinary methods. Consequently, the open-hearth steel in G-E WHITE remains ductile, easy to bend – means fewer on-the-job delays and more profits for you.

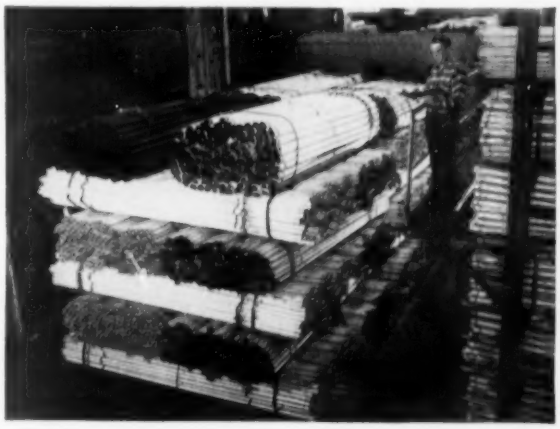
ANOTHER DIFFERENCE IMPORTANT TO YOU

You'll notice another difference in conduit when it comes to pulling wires into G-E WHITE. The smooth, low-friction interior coating can reduce wire pulling effort up to 14% . . . makes pulling through tight bends a quicker job.

G-E WHITE rigid conduit is built to work right to help you get the job done quicker . . . built to serve right for dependable installations that last longer.

Try G-E WHITE on your next job and find out that *the difference in conduit* may be the big difference in your profits.

Your General Electric distributor stocks an ample supply of G-E WHITE to handle your needs. Ask him for detailed information, or write for literature to Section Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.



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GENERAL ELECTRIC

NEW! PORTER® QUIK-STIK POLYETHYLENE ELECTRICAL TAPE

PORTER SINGLE-PAK
(¾ in. x 66 ft.)

Remains flexible in cold weather!

PORTER
JOB-PAK
(¾ in. x 20 ft.
—12 rolls)

Check the outstanding features of this one wrap primary insulation tape!

- Remains flexible from —70°F to +200°F.
- Total dielectric strength more than 10,000 volts.
- Maintains constant power factor over extremely wide frequency range.
- Resists corona conductivity; moisture; oils; greases; solvents; chemicals; fungi; bacteria; abrasion; creep; aging.
- Physically stable; non-corrosive; non-drying; non-polarizing; chemically inert.

Order from your wholesaler today!

For more information, write: *H. K. Porter Company, Inc., Quaker Rubber Works, Philadelphia 24, Pa. or Pioneer Works, Pittsburg, Calif.*

H. K. PORTER COMPANY, INC.
QUAKER RUBBER DIVISION

Shaver Outlet (56)

Model F-100 electric shaver outlet incorporates the necessary components to change household ac voltage to dc and is designed to increase speed and power of any ac-dc electric shaver. Easily installed in an ordinary duplex receptacle wall box, the unit has a replaceable fuse to protect the unit from shorts or inadvertent plugging-in of some device other than a shaver.

Wellsco Electronic Products, 15236 Erwin St., Van Nuys, Calif.

Wire (57)

Type RHH wires for general purpose wiring are now available with silicone rubber insulation and asbestos braid. Rated at 600 volts, their added heat resistance (90°C rating) makes them especially suited to power and lighting installations in factories, boiler rooms, railroad shops, and other heat problem areas.

General Electric Co., Bridgeport 2, Conn.

Receptacles (58)

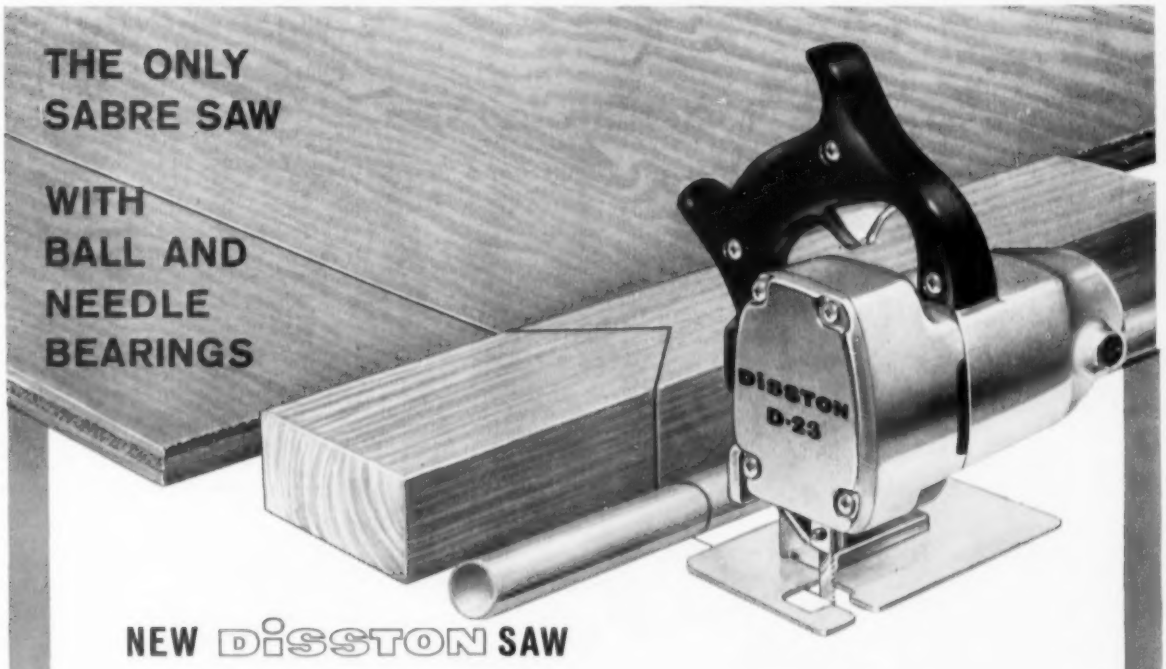
The Eagle weatherproof duplex parallel ground receptacle has a one piece, single hinged cover to assure protection against adverse weather conditions. A stainless steel spring automatically locks the cast metal cover against the receptacle while a rubber weatherproof gasket helps keep out dirt, dust, dampness, and rain. Receptacle has polarized slots which will accommodate both regular and polarized caps. Of solid brass plate aluminum finish, the unit is rated at 15 amps, 125 volts, and can be used on 125-volt grounding systems in accordance with the NEC.

Eagle Electric Manufacturing Co., Inc., 23-10 Bridge Plaza South, Long Island City 1, N. Y.

Product Briefs

(59) Porto Pac is the name given to a new **voltage regulator** which provides three outlets of 20-amp capacity at constant voltage for portable tools; manufactured by Easco Products, Ypsilanti, Mich. . . . (60) A grid fixture **hanger** offered by Daniel Woodhead Co., Chicago, Ill., mounts any fixture, cabinet, or curtain wall to "T" bar grid without the use of tools.

(61) Rol-away Truck Mfg. Co., Inc., Portland, Ore., announces a



NEW DISSTON SAW

FASTER THAN ANY OTHER SABRE SAW FOR CUTTING IN METAL, WOOD, PLASTIC

The D-23 Electric Hand Saw offers entirely new features in fast, versatile cutting for professional jobs. Competitive tests prove the D-23 is 15% to 50% faster than all competitive saws. And it's made by DISSTON, a famous name in saws for more than 100 years. Only **$98.50**

"ORBITE" Action gives the DISSTON D-23 Electric Hand Saw its fast, clean cut. It reduces blade wear, too. The blade has an orbital motion (3,800 strokes per minute). It cuts on the up-stroke, moves away from the material on the down-stroke. The result is less fraying of edges, truer cuts on circles, scrolls, straight lines or bevels.

Detachable Cord. The DISSTON D-23 has a detachable bayonet socket electric cord so you can select the cord length of your choice. Extra, easy-to-change blades come with the saw for use in plywood, 2x4's, plank lumber, sheet metal, pipes, tubing and plastics.

H. K. PORTER COMPANY, INC.
Henry DISSTON DIVISION

FREE BOOKLET

Mail this coupon today for an illustrated booklet outlining many other convenient and exclusive features of the DISSTON D-23. Instructions tell you how you can get the most out of your electric hand saw.

H. K. PORTER COMPANY, INC.
Henry DISSTON DIVISION
710 Tacony, Philadelphia 35, Pa.
Please send me without obligation the booklet about the new DISSTON D-23 Electric Hand Saw.
Name _____
Street Address _____
City _____ *Zone* ____ *State* _____

Electrician saves twice with *Ramset*® fastening tools!

Here is how Harrington Electric Co. used Ramset and Shure-Set® on new Cleveland building

Harrington electricians use powder-actuated RAMSET to fasten overhead strip lights, firing anchors into beams wherever needed. No pre-drilling or setting. Fasteners and charges are carried in the pocket of the operator's RAMSET apron.

Another Harrington electrician fastens floor conduit with his hammer-in SHURE-SET tool. Drives like a nail, holds like an anchor, in concrete subfloor.

Other contractors also using RAMSET products on this 23-story office building: The Feldman Bros. Co.; Korner Sheet Metal Co.; Geo. A. Fuller Co.; Johnson Service Co.; The Gellin Acoustical Co.; Smallwood Plastering Co.; E. J. Brandt Co., Inc.; and Builders Structural Steel Corp.

Ramset Fastening System

WINCHESTER-WESTERN DIVISION
OLIN MATHIESON CHEMICAL CORPORATION

12105-J BEREA ROAD • CLEVELAND 11, OHIO

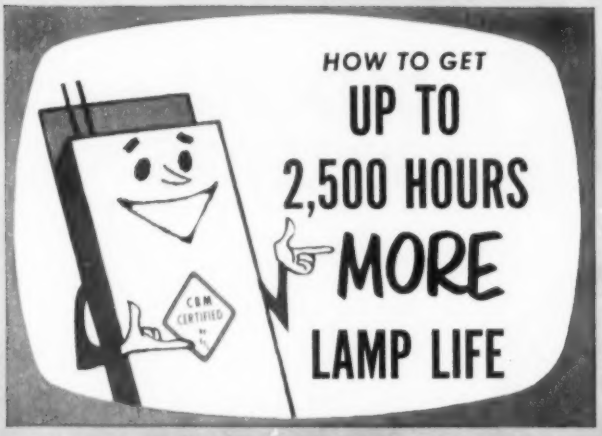
new spring loaded **safety ladder** which can be depressed and locked into positive bearing position by a simple pedal on its bottom step. . . . (62) A new line of electric **generating plants** has been announced by Pioneer Gen-e-motor Corp., Chicago, Ill. . . . (63) Performance both as a wire cutter and as an installation plier for self insulated terminals are features of a new **hand tool** manufactured by the Thomas & Betts Co., Elizabeth, N. J.

(64) Orbital action of its blade characterizes an **electric hand saw** manufactured by Porter-Cable Machine Co., Syracuse, N. Y. . . . (65) Mathias Klein & Sons, Chicago, Ill., has announced a shear **cutting plier** featuring a quickly removable shearing blade.

(66) Control of all boom movement and travel from its platform are features of a self propelled **aerial platform** manufactured by the Pitman Mfg. Co., Kansas City, Mo. . . . (67) University Loudspeakers of White Plains, N. Y. has introduced a new wide angle distribution **public address projector** which can be rotated 360 degrees on an omni-directional swivel mounting. . . . (68) An insulated **safety link,** which protects hook tenders, riggers, and men who work with "pullers" on energized electrical conductors, has been developed by E. D. Bullard Co., Sausalito, Calif.

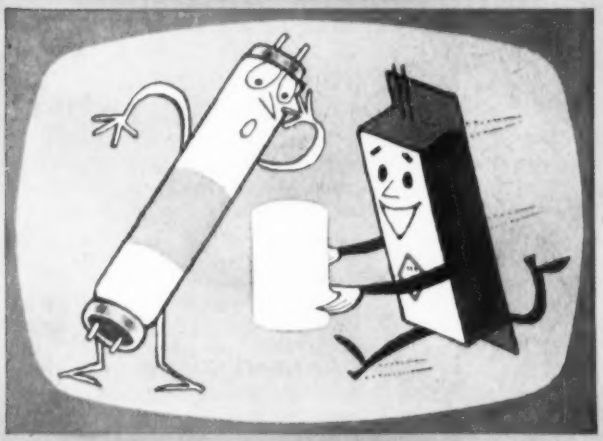
(69) Newly developed Tuffcote is an abrasion resistant **tree wire** for service in tree growth areas spanned by telephone transmission lines and is offered by National Electric Products Corp., Pittsburgh, Pa. . . . (70) General Electric Co., Cleveland, Ohio is manufacturing a 100-watt household **light bulb** of higher light output in a bulb identical in size to their present 75-watt bulb. . . . (71) To the line of materials-handling trucks manufactured by Rol-Away Truck Mfg. Co., Inc., Portland, Ore. has been added a high ladder **maintenance truck** capable of a 16 ft reach.

(72) The Yale and Towne Mfg. Co., Philadelphia, Penna., has developed a workman's **platform and boom attachment** for industrial lift trucks to accomplish overhead maintenance tasks involving bulky or heavy pieces of plant equipment.



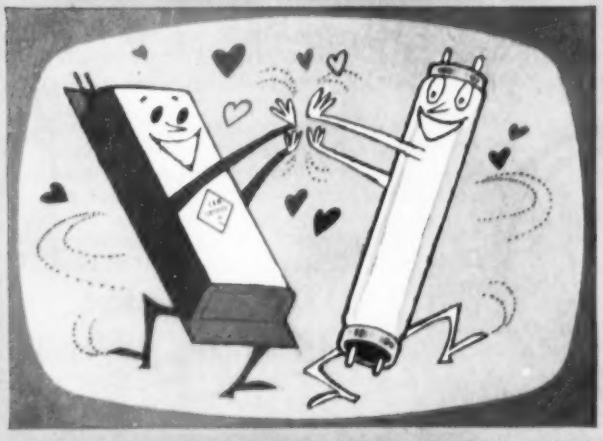
HERE'S THE SECRET: Use fixtures with CERTIFIED CBM BALLASTS! They can give up to 2500 hours more lamp life than fixtures using ballasts of poor design as tests by fluorescent lamp makers show.

CBM GIVES JUST WHAT YOU NEED for proper fluorescent lamp operation. These ballasts are designed to give just the right amps and volts for peak lighting performance.

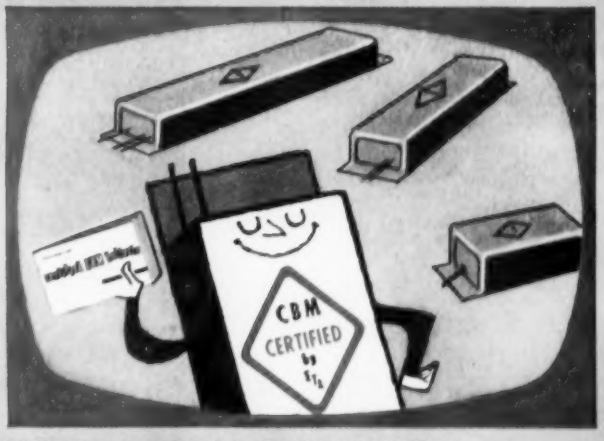


CBM BALLASTS GUARD YOU FROM LOSSES IN LIGHT OUTPUT . . . can save you up to 30%. For CBM means full, rated light output. And you get assured ballast life and High Power Factor, too.

BUILT TO EXACTING SPECIFICATIONS for performance by 7 leading ballast manufacturers, CERTIFIED CBM BALLASTS are checked *and certified* by Electrical Testing Laboratories. They also carry the UL label.



MADE FOR EACH OTHER. Certified CBM standards are "tailored to the tube". So to get more for your money, be sure the fixtures you use are equipped with CERTIFIED CBM BALLASTS.



WRITE FOR A COPY of the free booklet, "Why it pays to use CERTIFIED CBM BALLASTS in fluorescent lighting fixtures". You'll find it helpful in knowing your best buy in fixtures.

Seven leading manufacturers now make up

CERTIFIED BALLAST MANUFACTURERS

CBM-3-CB

2116 KEITH BUILDING • CLEVELAND 15, OHIO

Participation in CBM is open to any manufacturer who wishes to qualify

SELECT-O-PUSH SAVES SPACE WITHOUT SACRIFICING FUNCTION!

One unit, the Westinghouse Select-O-Push, combines a pushbutton and selector switch to do the job normally requiring two assemblies. It cuts panel-front space need by half.

When wired with a standard double-pole contact it becomes versatile in limited space, freeing valuable enclosure area.

The same attention to detail built into all Westinghouse controls applies to the Select-O-Push. It functions excellently where moisture threatens. Tight-fitting gaskets, stainless steel shafts, precision milling—all help keep out harmful liquids.

A Guide to Control (B-7022) will tell you more about Oil-Tite* controls. The new 72-page *Push-button Guide* (B-6749) will give you information on the complete line. Write to Westinghouse, Box 868, Pittsburgh 30, Pa. *Trade-Mark J-30254

YOU CAN BE SURE...IF IT'S

Westinghouse

CATALOGS and BULLETINS

(73) SILICON RECTIFIERS for high-current applications including resistance and arc welding, metal finishing, battery charging and large-tube filament power. Bulletin GEC-1470, 2 pages, lists features, discusses characteristics, and provides graphic performance data. General Electric Co.

(74) BUILDING & LIGHTING CABLE, Type RR. 4-page bulletin gives complete specifications for cable combining Type RH-RW, Type RHW, Triozone, and Trioprene insulations. Triangle Conduit & Cable Co., Inc.

(75) FLUORESCENT BALLASTS for plastic signs and other non-weatherproof service. Bulletin FL-290 includes wiring diagrams for 15 types of ballasts for outdoor service plus information on indoor ballasts and mercury vapor lamp transformers. Sola Electric Co.

(76) LIGHTING EQUIPMENT. New 52-page bulletin covering floodlights, searchlights, aviation lighting, industrial lighting, and fixture Condulets. Descriptions are given, along with catalog number and list price. Crouse-Hinds Co.

(77) AIR CONDITIONING CONTROLS. 4-page booklet explains and illustrates the correct application of electronic controls to air conditioning and air distribution installations. Barber-Colman Co.

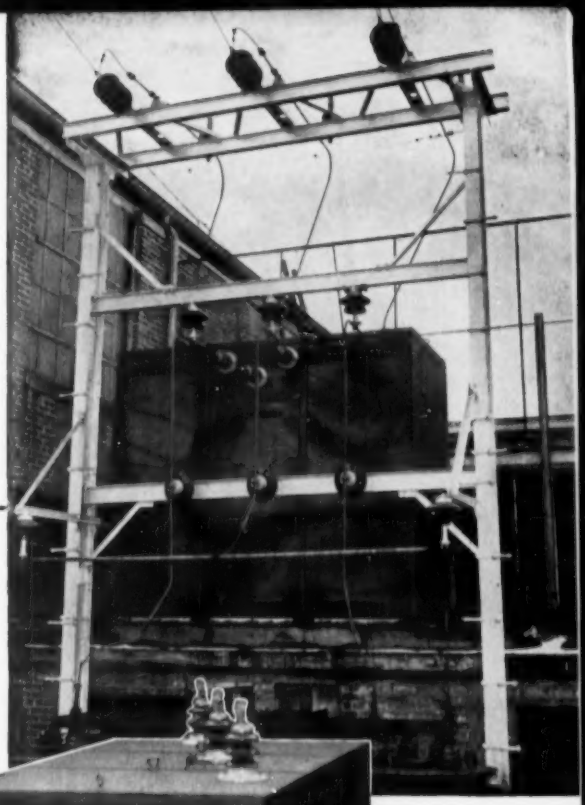
(78) HORIZONTAL BREAK SWITCHES rated at 7.5 through 69 kv, 600 amps, for such substation uses as connecting and disconnecting power transformers and for isolating oil circuit breakers. Bulletin PSE4, 12 pages. Line Material Industries.

(79) CAPACITORS—how to use them. Bulletin GEA-5632B, 12 pages, describes the why, where and how of industrial capacitor applications. General Electric Co.

(80) FLUORESCENT UNITS. New 16-page engineering folio presents specifications, cross-sectional drawings, distribution curves and coefficients of utilization for wide line of shielded luminaires. Catalog S-58. Gruber Brothers, Inc.

How S&C "JOB MATCHED" Metalclad Switchgear saved 50%

for Twin Disc Clutch



Typical high-voltage power supply systems for industrial plants are rarely exposed to faults, either transient or permanent. For that reason they can use the simple radial form of power distribution, and dispense with high-priced protective equipment that provides automatic reclosure against faults. Reliable interruption of permanent faults and occasional switching is all that is required; and this is provided by S&C Metalclad Switchgear.

The plans for doubling the high-voltage power system capacity at Twin Disc Clutch Company included S&C Metalclad Switchgear for the high-voltage switching center... the 3-unit assembly is shown. In addition to the substantial economies resulting from elimination of complex equipment, S&C gear saved valuable ground space normally required for an open structure.

Experienced S&C engineers will be glad to assist you in building economy into your high-voltage power supply.

Exum French, President, B. & F. Hi Line Construction Corp., Rockford, supervised the installation.

Specialists in High-Voltage Switchgear for Electric Utilities since 1910

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Toronto 14, Ontario

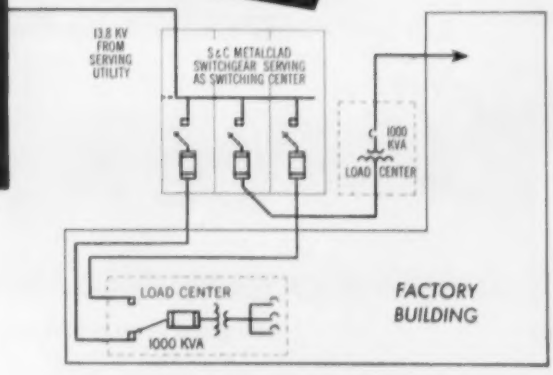


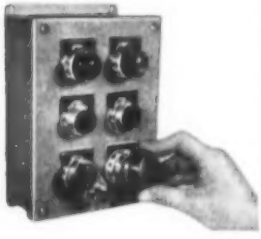
Diagram at right shows use of S&C Metalclad Switchgear in radial-type circuit at Twin Disc Clutch Company

INTRODUCING THE New

FURNAS ELECTRIC

Oil Tight PUSH BUTTONS

DESIGNED FOR EVERY APPLICATION



Now for the first time, because of standardization and interchangeability, more combinations of Oil Tight push buttons are available with fewer parts. As a result, Furnas Electric design and research again lead the field, this time with the finest oil tight push buttons available.

When you specify Furnas Electric, you get one standard contact block. No rights or lefts—no special units for horizontal or vertical mounting.

Accessories (key lock, mushroom head or lever) are mounted directly on all standard operators. Operators need not be modified or removed from panels.

For full information on oil tight or general purpose push buttons, selector switches or pilot lights, write today for Catalog 5606. Furnas Electric Company, 1067 McKee Street, Batavia, Illinois.

A16

FURNAS 25TH YEAR

FURNAS ELECTRIC COMPANY

BATAVIA, ILLINOIS

SALES REPRESENTATIVES IN ALL PRINCIPAL CITIES

(81) INDUSTRIAL CONTROLS for counting and weighing and for control of bulk flow, packaging, liquid levels and motion. 4-page Form 84-272 illustrates and describes typical applications. Micro Switch, Div. of Minneapolis-Honeywell Regulator Co.

(82) SHADED POLE MOTORS in 24 models for long-life applications such as blowers and fans. Photos and complete specifications are given in 4-page bulletin. Controls Co. of America.

(83) RESISTANCE WIRE AND RIBBON for heating element design. 20-page booklet M-57A describes Cromel-A products, including examples of calculating design factors for appliance and furnace elements. Hoskins Mfg. Co.

(84) FLUORESCENT LAMP BALLASTS. "Is the UL Label on a Ballast Really Enough for You?" is the title of a folder outlining the difference between UL listing and CBM emblem. Certified Ballast Manufacturers.

(85) NUMERICAL POSITIONING CONTROL. Bulletin GEA-6594, 8 pages, describes complete industrial system for automatic point-to-point positioning of machines and machine tools. General Electric Co.

(86) LIGHT SWITCH. Quiet "Tap-Lite" switch rated at 15 amps, 120 or 277 volts, ac, is pictured, dimensioned and described in new Data Sheet 135. Device is appropriate for equipment using on-off control. Micro Switch, a Div. of Minneapolis-Honeywell Regulating Co.

(87) STREET LIGHTING TRANSFORMERS. New bulletin SL-703 describes mechanical and electrical aspects of various types. Moloney Electric Co.

(88) MAGNETIC STARTERS, size 0 and 1, for such applications as machine tools, pumps, hoists, blowers, saws, fans and motor control centers. Bulletin GEA-6611, 20 pages, describes all available forms and enclosures. General Electric Co.

(89) CIRCUIT RECLOSERS and accessories for substation use. Bulletin CR1CA, 16 pages, provides information on tripping, current metering, externally-controlled closing, tripping and lockout, dual reclosing time intervals, and other special operations. Line Material Industries.

(90) TRANSFORMER CONNECTORS. Two-part article describes various types of internal connectors used in modern distribution transformers, plus common types of high and low voltage external connectors. Kuhlman Electric Co.

(91) POLE-TOP CAPACITORS. Bulletin GEA-6543, 12 pages, discusses the trend to auto-switched capacitor equipments for distribution circuits, describing equipment and controls available. General Electric Co.

(92) TRANSFORMERS which are self-protecting against lightning, overloads and short circuits and are rated from 3 to 100 kva at 15 kv and below. Bulletin 61B7309C. Allis-Chalmers Mfg. Co.

(93) UNIT SUBSTATIONS. Bulletin SD-61, 8 pages, explains advantages of using packaged substations in modern electrical systems. Square D Co.

(94) PANELBOARDS. Bulletin GEC-1477, 4 pages, describes line of plug-in power panelboards designed for control and protection of single- and 3-phase power, distribution, lighting and appliance circuits up to 240 volts ac. General Electric Co.

(95) DIRECT-DRIVEN FANS available in ring, square panel or duct types in sizes from 24 to 48 in. are described and illustrated in 4-page Bulletin 775. Aerovent Fan Co.

(96) DISCONNECT SWITCHES. 4-page Bulletin GEA-6751 gives detailed information on new line of adjustable shaft disconnects in 30, 60, 100 and 200-amp sizes. General Electric Co.

(97) ROOF VENTILATORS. Bulletin SDA-220 contains features, construction details, ratings, performance data and dimensions on both belt drive and direct drive roof ventilators up to 60 in. in diameter. Peerless Electric Co.

(98) SPRING DOOR COVER for use with any duplex outlet is illustrated in 4-page folder No. 2932. Pass & Seymour, Inc.

(99) THERMOSTAT ACCESSORIES, including cases, devices for adjusting temperature controls, mounting brackets and stuffing boxes are detailed in Bulletin RT-819, 4 pages. Robertshaw-Fulton Controls Co.

New RIDGID 4PJ Geared Threader * is now JAM-PROOF

"...It's Safe, Boss...
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...It Won't Jam"
Patents Applied for
RIDGID 400A Power Drive with Universal Drive Shaft operates 4PJ Threader on 2½" to 4" conduit held in Tristand Chain Vise, all RIDGID products.

*Automatically Stops Threading After Standard Length Thread Is Cut

Power drive threading is safe and easy with this new 4PJ—no more watching of either die stock or drive! 4PJ can't jam—drive pinion kicks out automatically after full thread is cut. Extra-easy to handle . . . mistake-proof workholder, no bushings . . . fully enclosed gears . . . RIDGID most-for-your-money—Buy new 4PJ at your Supply House!

The Ridge Tool Company, Elyria, Ohio, U.S.A.

RIDGID
Work-Saver Pipe Tools

Reader's Quiz

QUESTIONS from readers on problems of industrial equipment, installation, maintenance and repairs. Answered by electrical maintenance engineers and industrial electrical contractors out of their experience. For every question and every answer published we pay $5.00.

Phase Addition

QUESTION R32—In our plant we have a 3-phase, 3-wire delta 240-volt power distribution system. For lighting we connected a delta-star bank of transformers. Now, we do get 120 volts necessary for lighting, but checking further, we found that we are getting only about 208 volts between phases, and this is with no load. Will someone explain this phenomenon?—J.M.

ANSWER TO R32—I suppose J.M. assumes he should get 240 volts between phases. The reason he gets 208 volts is because this is a 3-phase circuit and the three phases all reach maximum voltage at a different time. If J.M. and a neighbor each pushed his car with a maximum of force of 120 lbs, but each reached the maximum push of 120 lbs at a different time, then the total force on the car would never be 240 lbs. In these 3-phase star circuits the voltage between phases is the square root of three or 1.732 times the phase to neutral voltage:

1.732 x 120 = 208 volts. —P.S.

ANSWER TO R32—When transformers were supplied and connected to the 240-volt service, no doubt the object was to obtain both power and lighting from the same transformers. To do that, it is standard practice to install the 4-wire system to obtain 120 volts for lighting and 208 volts for power. The transformers in this case have a transformation ratio of 2 to 1. A fourth line is brought out from the neutral point of the star connection and between this fourth wire and any of the other three wires you will read 120 volts.

The three star windings of the secondary of the transformer setup are 120 degrees apart in time space. The resultant of two forces working 120 degrees apart is obtained by solving for the third side of the triangle which has two sides of the triangle of equal value which in this case is 120 volts. The resultant value of these two forces is 208 volts.

Had transformers been installed to give 220 volts for motors or other equipment, the lamp voltage would be 127 volts which is too high. If you have 220-volt motors running on a 208-volt line, you are still running them on a voltage within 10% of the nameplate value. Starting torque is decreased approximately 10% and current is increased about 5% in the case in question.—B.A.S.

Outlet Box Mounting

QUESTION S32—I have a large building to wire, which is constructed entirely of white cinder blocks. There will be plaster or stucco on the inside wall or partitions. They are to be painted.

All wiring is to be concealed and all outlets are to be flush. I therefore intend to use all UF wire going down through inside of the blocks. The owner does not want any patching done around the edges of the boxes, as the patches would show up against the normal white color of the blocks.

My problem is how to keep wall case or box from either falling out of the block when a plug is pulled from the outlet, or falling in the block when a plug is pushed into the outlet. This will also apply to wall switches for the overhead lighting. All power outlets are to be buried in the floor.

At first I was going to use thin-wall but the owner does not want any surface work at all.

Do you know of a holder that will do what I want it to do, that is, to keep the box locked tight in the cinder block?—J.P.W.

ANSWER TO S32—Proceed as follows:

1. Remove ears from wall cases (switch boxes) and cut out the cinder blocks so that the box fits neatly into the opening.

2. Connect your wiring through top knockouts, OR bottom knockouts, OR side knockouts and let the box hang on the cables.

3. With a paint brush and plenty of water saturate the whole area inside the wall opening; also wet the box all around.

4. With plaster of paris previously prepared, fill the opening, using a putty knife or scraper, so that as you tap the box in place, plaster will form around the top, back, and sides of the box. You might also place a gob of plaster on the box before entering it into the opening.

After the plaster sets, your outlet is as strong as the masonry itself. Should the opening in the cinder block be too deep, build it up first with plaster and chunks of cinder block or brick until a desirable depth is achieved, then proceed as above.—S.S.

ANSWER TO S32—I suggest the use of a type of box support such as is manufactured by the Blackhawk Industries whose advertisement appears on page 198 of the July issue of EC&M. There is also another type called "Madison Hold-Tites" which can be used. These would eliminate the necessity of stocking assorted supports for single and ganged outlet boxes. National Electric and Raco also manufacture another type complete with box that is designed on a clamp idea.—E.M.G.

ANSWER TO S32—There is a box holder shaped like a letter U which can be fastened to the box with one bolt and nut. Then the box with holder attached is pushed into the opening and the holder spread out about ½ in. on each side of the box at point of contact with cinder or concrete block on the inside of the opening. The plaster ears are left on the box flush with front of box so the box almost falls into the opening. These holders are primarily for dry wall construction, but can be used on any thickness of block by using a longer bolt. This makes a very strong support.

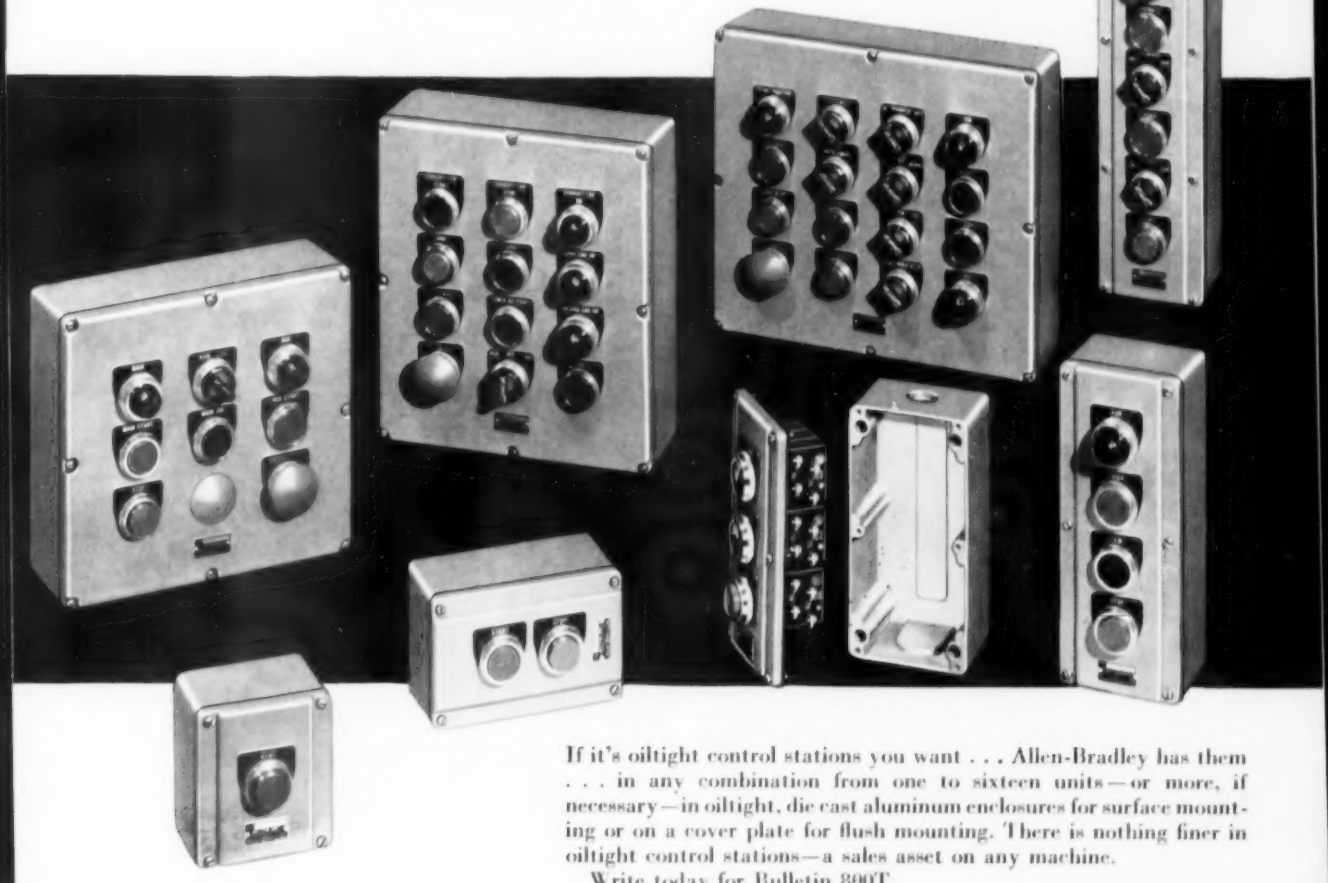
For two or three gang boxes, I would suggest using two holders, one at each end of the ganged box and put them up vertically instead of horizontally. You can get some sheet iron strips cut by a tinsmith to use where vertical straps are necessary as the regular ones are only 2¼ in. side. These holders stay behind the blocks and don't have to be built into the box.—E.E.M.

Transformer Sizing

QUESTION T32—We are designing some portable test equipment which will include a 15-hp, 3-phase, 220-volt motor and a transformer to supply it from a 550-volt bus duct. Can someone suggest the considerations involved in sizing the transformer? There seems to be

NOTHING FINER IN oiltight control stations

BULLETIN 800T

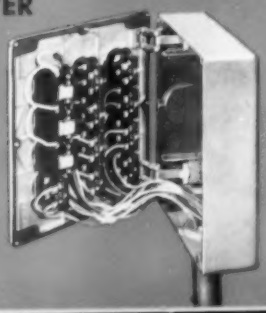


If it's oiltight control stations you want . . . Allen-Bradley has them . . . in any combination from one to sixteen units—or more, if necessary—in oiltight, die cast aluminum enclosures for surface mounting or on a cover plate for flush mounting. There is nothing finer in oiltight control stations—a sales asset on any machine.

Write today for Bulletin 800T.

HINGED COVER

The 9, 12, and 16-unit control stations have hinged covers. The hinge can easily be changed in the field from one side to the other.



ALLEN-BRADLEY

MOTOR CONTROL

QUALITY

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.
In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

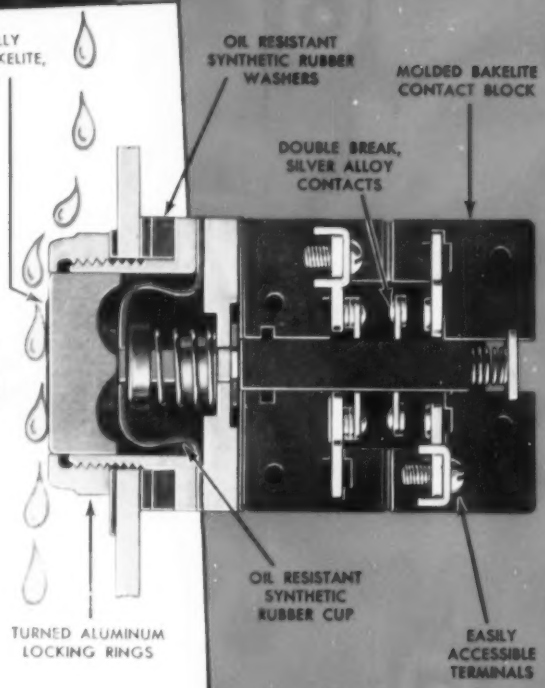
10-57-RM

for machine tool application . . .

BULLETIN 800T oiltight control units

These rugged, reliable units were designed as pilot controls for a-c and d-c magnetic motor control. The oil resistant synthetic rubber cup and washers keep cutting fluids and oil away from the contacts, and thus prevent trouble. Push button units can be furnished with one, two, or four contact blocks—each equivalent to a separate single pole, double throw, switch unit.

For attractive appearance plus long life with reliable operation, select Allen-Bradley control units.


LARGE, FULLY GUARDED, BAKELITE, BUTTON
OIL RESISTANT SYNTHETIC RUBBER WASHERS
MOLDED BAKELITE CONTACT BLOCK
DOUBLE BREAK, SILVER ALLOY CONTACTS
OIL RESISTANT SYNTHETIC RUBBER CUP
TURNED ALUMINUM LOCKING RINGS
EASILY ACCESSIBLE TERMINALS

PUSH BUTTONS

Flush Head "Start" Button

Extended Head "Stop" Button

Mushroom Head for Easy Operation

Push Button with Cylinder Lock

Push Button with "Selector" Sleeve

Wing Lever Push Button

Maintained Contact Push Buttons

SELECTOR SWITCHES

Three-Position Selector Switch

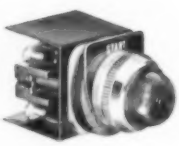
Two-Position Coin Slot Selector Switch

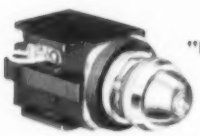
Wing Lever Selector Switch

Selector Switch with Cylinder Lock

PILOT LIGHTS

Transformer Type Pilot Light


Full Voltage Pilot Light


"Press-to-Test" Pilot Light

A-B QUALITY

ALLEN-BRADLEY
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QUALITY

Allen-Bradley Co.
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In Canada: Allen-Bradley Canada Ltd., Galt, Ont.

10-57-RM

a difference of opinion among transformer manufacturers.—R.E.B.

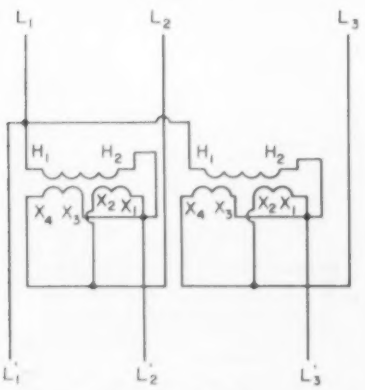
ANSWER TO T32—Perhaps the reason for the difference in opinions among the transformer manufacturers is because there are several ways to make the desired transformation.

The first step in any selection would be to determine the 3-phase kva load. From your statement, the only consideration is a 15-hp 3-phase motor. Assuming that full-load current of the motor is 40 amps, the kva requirement would be 40-amp x 220-volt x $\sqrt{3}$ = 15.25 kva. The next step is to determine what transformer arrangements would be more economical to use.

1. Delta-delta transformation—This connection would utilize three single-phase transformers, each with a 600-volt primary and a 240-volt secondary, and connected delta-delta. The kva size of each would merely be the total load divided by three; or 15.25 ÷ 3 = 5.08 kva. Since a 5 kva transformer is standard size, you should use three 5 kva transformers.

2. Open-delta—This connection would require two single-phase transformers each rated as in (1) and connected identically as a delta-delta except that one transformer is removed. With an open-delta, the output kva is 86.6% of the kva of the two transformers. In this case, the size transformer bank required would be 15.25 ÷ 0.866 = 17.5 kva, and the rating of each transformer would have to be at least 17.25 ÷ 2 = 8.75 kva. Since 10 kva is the closest standard size, you would require two 10 kva transformers for the open-delta configuration.

3. Auto-transformer — For 3-phase connections, the auto-trans-



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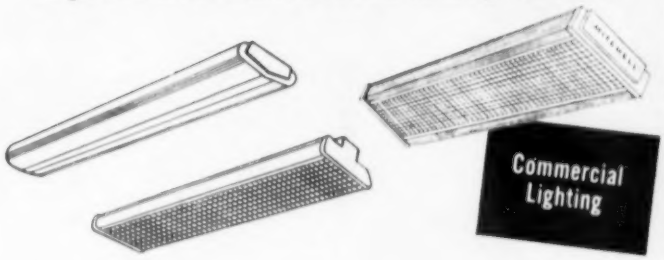
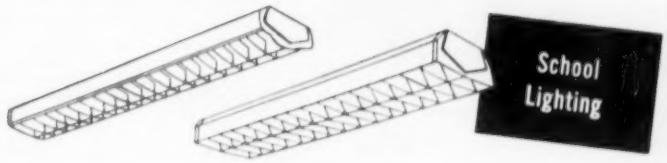
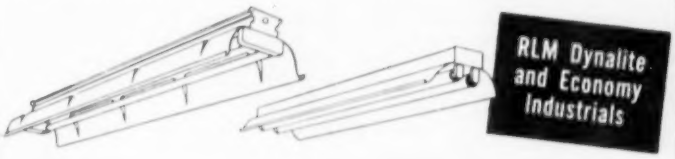


Commercial Lighting



School Lighting



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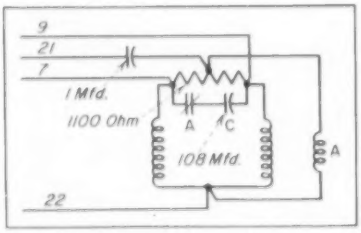
former is by far the most complicated. It does have the advantage of permitting smaller sized transformers for any given installation compared with the delta-delta or open-delta. We have used the connection shown in the above diagram for transformations from 550 to 460 volts. Since single speed motors in the 15 hp class are almost universally 220/440-volt, perhaps you could use the same connection on 440 volts.

The minimum size for each transformer is the 3-phase load kva divided by 7.95 to give 1.92 kva or a standard 2 kva. In this case therefore you would require only two 2 kva transformers, each rated 600—120/240 volts.—I.G.B.

ANSWER TO T32—In sizing transformers, it is safe to assume that one kva is required for each horsepower, in fact, this is a rule of thumb used by design engineers for many years. Therefore, since you have 15 hp, you need a 15 kva transformer with a 550-volt primary and 220-volt secondary.—J.M.

Reversing Circuit

QUESTION U32—Below is a diagram of a master reversing valve motor. I would like an explanation for the action of relay A.



There is a constant voltage across leads 21 and 22. Voltage is applied to 9 or 7 to drive the valve in the direction desired. 9-7-21 are of the same polarity.—V.W.B.

ANSWER TO U32—The circuit shown is that of a reversible capacitor-type motor, in which the starting capacitor circuit is controlled by a potential type Relay A. This relay is energized by a counter EMF generated by the winding which at the time is in series with the 108 mfd capacitor and relay contacts A. The winding that functions as starting winding, depending on rotation desired, is determined by whether the 9 or 7 lead is connected to lead 21.

At starting, if 9 and 21 are connected together, the motor winding

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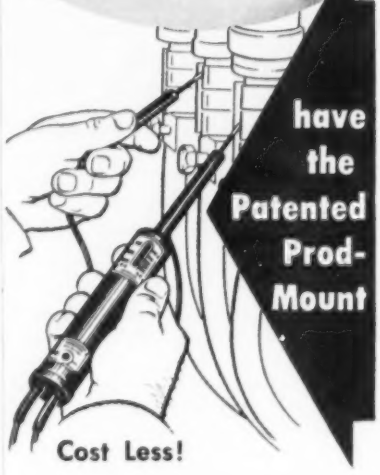

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connected to 7 will be the starting winding; if 7 and 21 are connected together, the other section will serve as the starting winding.

Assume that 9 and 21 are connected together. The motor will start with the 108 mfd capacitor in the circuit as contacts A are closed. When the motor has picked up speed to the proper rpm required, counter emf will be generated by the starting winding and relay coil A will become sufficiently energized to pull relay contacts A apart, opening the starting circuit.

Relay coil A will continue to hold contacts A open as long as the motor is running, due to combined action of line voltage through a section of the 1100 ohm resistance, 1 mfd capacitor, and the counter EMF of the starting winding. Also, while relay contacts A are open, the auxiliary motor winding will draw a small current (out of phase with that in the main winding) through the resistor-capacitor circuit. This improves the operating characteristics of the motor.—L.N.W.

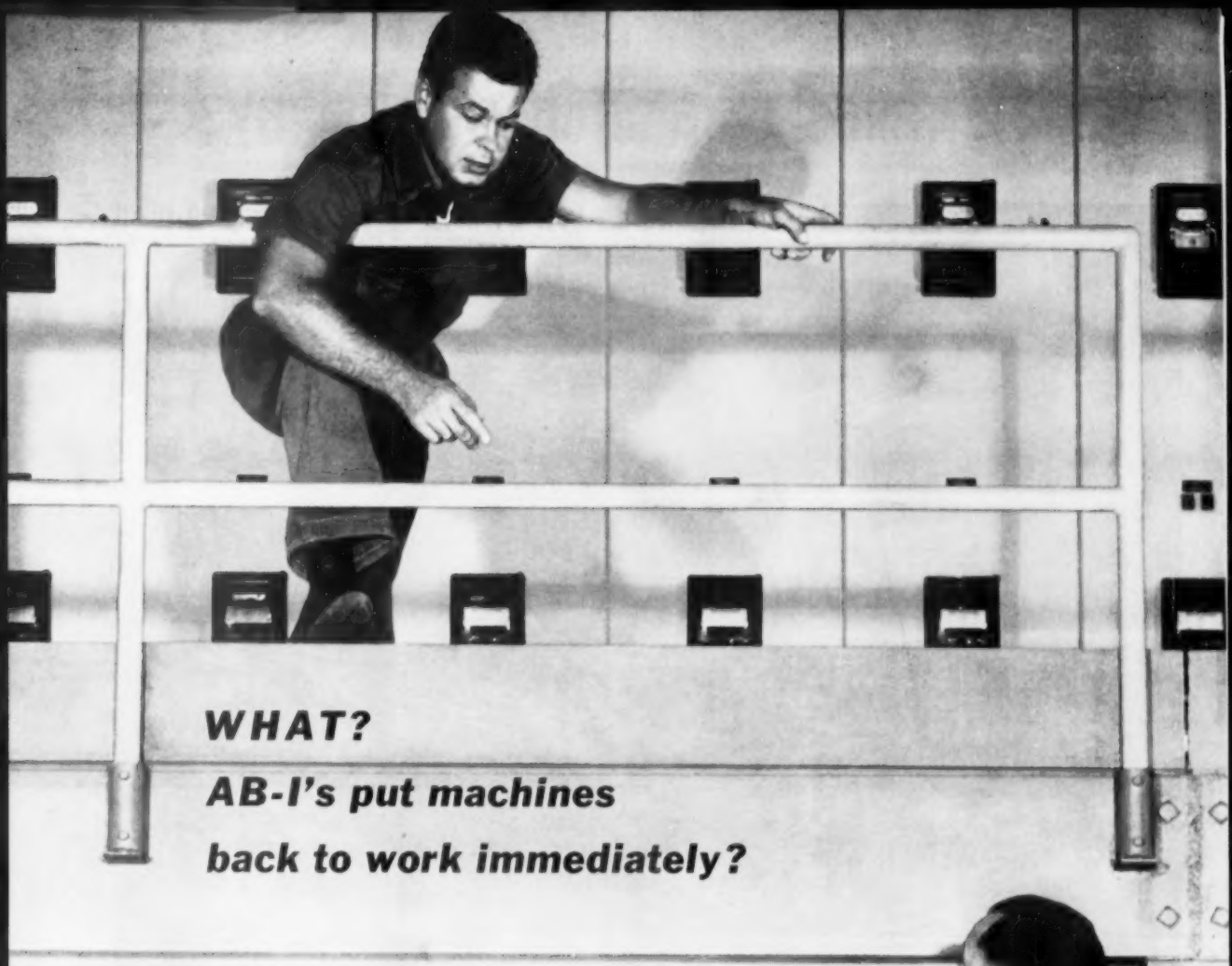
Can You ANSWER These QUESTIONS

QUESTION B33—I have heard it said that the wye-wye 3-phase transformer connection with three single phase transformers and a grounded neutral is unpopular. Can someone explain?—R.E.B.

QUESTION C33—We have in our plant two 100 hp sump-pump motors, rated at 480 volts, 3-phase, 60 cps that are located in a pit which becomes flooded with river water. Is there any method of reconditioning flooded equipment in place? What is the minimum insulation resistance at which the motor may be considered ready for service?—J.M.

QUESTION D33—Could a photographer's exposure meter be used as a light meter to measure footcandles of illumination of lighting installations? A regular meter is evidently difficult to purchase and expensive. Is the usual scale of an exposure meter marked off in footcandles or can footcandles be quickly determined by applying a multiplying factor? Will the scale of the exposure meter take care of all lighting installations?—E.B.

PLEASE SEND IN YOUR ANSWER BY NOVEMBER 15



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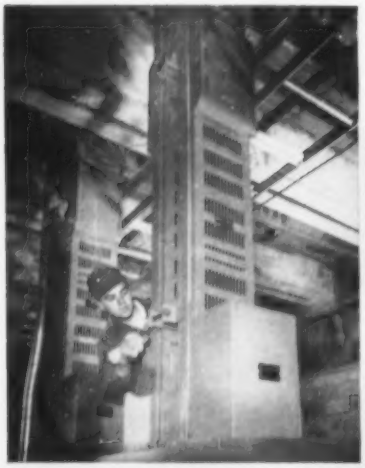
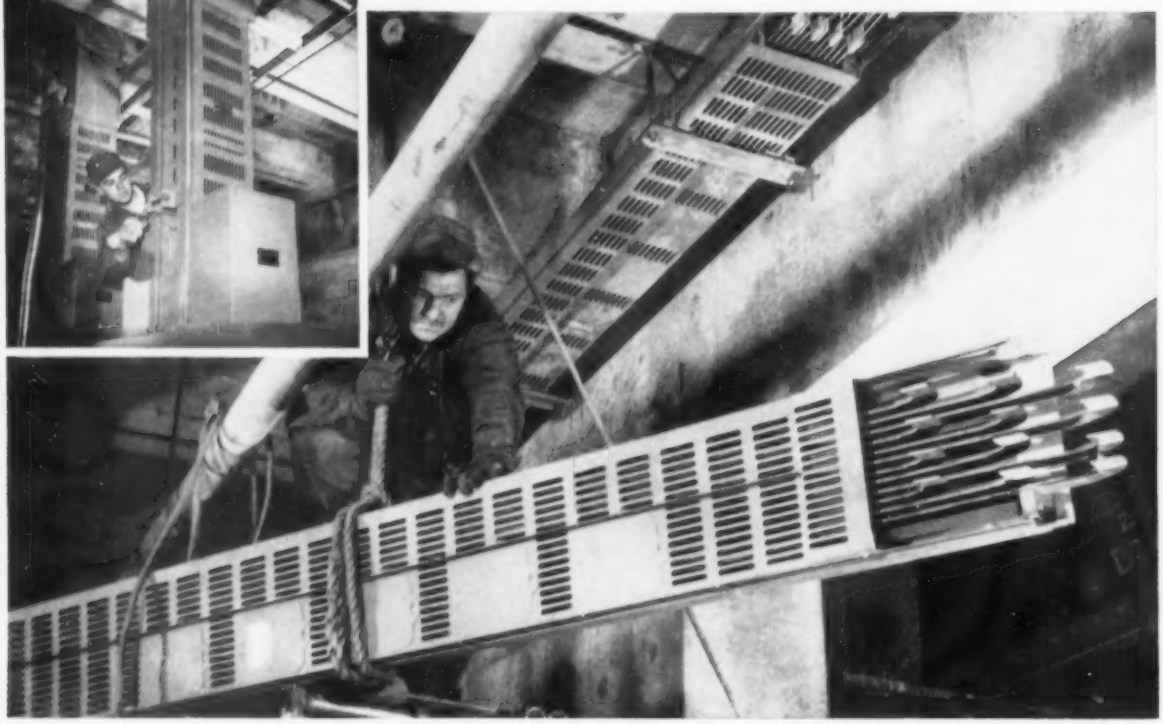


General Electric Type LVDP plug-in feeder busway with aluminum bars.



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Questions on the Code

Answered by:
B. A. McDONALD, *New York Board of Fire Underwriters, Rochester, N. Y.*
GLENN ROWELL, *Electrical Engineer, Fire Underwriters Inspection Bureau, Minneapolis, Minn.*
B. Z. SEGALL, *Consulting Electrical Engineer, New Orleans, La.*

Service Disconnects

Q. *In the April issue of EC&M on page 264, under the heading Service Overcurrent Protection, is stated: "This does not mean each single pole breaker must be rated 50 amps. The breakers can be each individually rated for 15 amps, for example."*

Is this supposed to mean that six angle pole breakers may be used as the six main disconnects as mentioned in Section 2351-a? It has always been my understanding that branch circuit disconnects could not be considered as main disconnects. In this area today, all services are 3-wire, therefore I do not see how six single pole breakers, or switches, or fuses can meet the requirements of Section 2353, 2351-a.

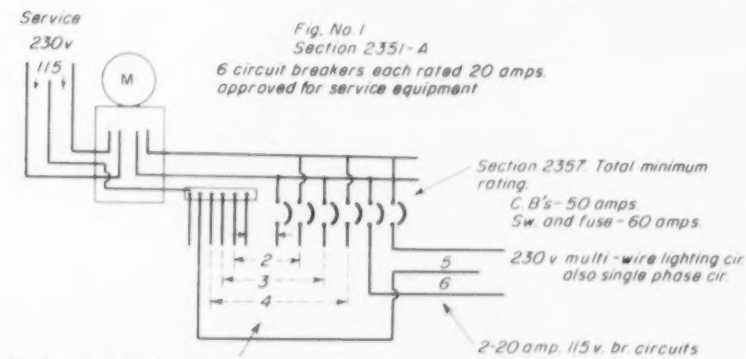
If I recall correctly, about 1949 or '50, there was on the market a panel with six single pole disconnects of 15-amp rating; this piece of equipment was discontinued as not meeting the Code requirements. A review of the following sections bring to light some differing opinions, some with my ideas, and some in line with those of Mr. Segall; Interpretations Nos. 288, 393, 423, 396, 377 and 180. May I have your personal opinion on the above?—C.L.

A. In order to clarify the question you have raised, I have shown by Fig. No. 1 an application which I personally believe fully satisfies the provisions of the N. E. Code. In this example we have six 20-amp circuit breakers which serve the dual purpose of the service disconnecting means, and the branch-circuit requirements of the occupancy involved. These breakers could be individually rated at 15 amps as mentioned in your question.

I do not see any conflict with Section 2353 which requires the simultaneous interruption of all ungrounded conductors, since an exception is made to this general provision for single phase circuits or multi-wire lighting circuits; and I don't see any conflict with the provisions of Section 2351-a. It is important to note however that this service equipment combination must be approved as service equipment and for prevailing conditions. Reference to page 289 of Underwriters' Laboratories Electrical Construction Materials List shows that such service equipment, approved by U.L., will bear their label. The only Code rule which would deny the application shown is Section 2373, quoted on Fig. No. 1.

The 1931 Code, through Section 405-b-2 recognized for the first time six circuit breakers, serving as 15-amp branch circuit devices, as the service disconnect for a single family dwelling subject to several other conditions of use. This rule, about 26 years old, was the forerunner to the present general provisions of Section 2351 and 2371, and I know of no Code revision in the interim which denies the use of six circuit breakers, acting as branch-circuit overcurrent devices, to be used as service equipment provided it is approved as such by U.L. I have reviewed the official interpretations quoted and I am unable to find where they influence the above opinion.

While the orginal rule, developed in 1931, only concerned circuit breakers, the 1937 Code further extended such recognition to six sets of switches and fuses, and many of the previous restrictions with respect to use were eliminated at that time.—B.A.McD.



Section 2373. If the service overcurrent devices are locked or sealed, or otherwise not readily accessible, branch-circuit overcurrent devices shall be installed on the load side, shall be mounted in an accessible location and shall be of a lower rating than the service overcurrent device.

Split Electric Range

Q. *Discuss the proper method to wire a split-unit electric range.—C.T.*

A. By proper method I take it to mean you would like to have the code requirements for such installations. Per se, the code at the present time does not have rules for this particular installation. The Electrical Section of the NFPA recognizes that this is a specific problem for the entire United States and I believe that the Chairman of this Section has a Technical Subcommittee actively studying this problem.

B. A. McDonald in the March 1956 News Bulletin of the International Association of Electrical Inspectors discussed this problem at length. It should be understood that this discussion represents Mr. McDonald's thinking only, and is in no way an official interpretation. However, he does bring out many pertinent points and it would be well to review this article.

The writer, within the scope of his own work of designing several installations for clients, has found in each case that it was necessary to wire each unit as a separate circuit and in the case of the oven and the griddle units the branch

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circuits were designed for 100% loading. As for the cooking top, two cases required 100% loading branch circuits and one case worked out quite satisfactorily when an 80% demand factor was applied to the loading.

I can only caution you to work these out to fit your particular case and by all means discuss each situation with your local inspection authority.—B.Z.S.

Lighting Fixtures for a Garage

Q. *Does the Code require lighting fixtures mounted on the ceiling of an open air parking garage to be of the double globe type when such fixtures are mounted less than 12 feet above the floor?—M.G.*

A. Actually the National Electrical Code does not differentiate as yet between an open air parking garage and an ordinary enclosed building. However, the new standard for garages just published by the National Fire Protection Association does make the statement under Section 2011 that open air parking structures are not generally considered hazardous areas and that the electrical wiring, equipment and apparatus therein need not comply with the provisions of Article 510 of the National Electrical Code unless they are located below grade or are within 20 ft horizontally of gasoline dispensing pumps. Inasmuch as the standards for garages and the National Electrical Code are both the products of individual committees appointed by the same organization, it is assumed that the standard bearing the latest date of publication should be used. However, if this is a controversial point, I personally would recommend that an official interpretation be requested from the National Electrical Code Committee. —G. R.

Two-Wire Caps Polarized or Not

Q. *After 20 years of electrical maintenance and construction in domestic and industrial fields, I am puzzled by the indifference to a stipulation in the code on circuit wire identification; i.e., the white wire in a 110/125-volt branch circuit.*

It has always been my contention that this white wire be identified

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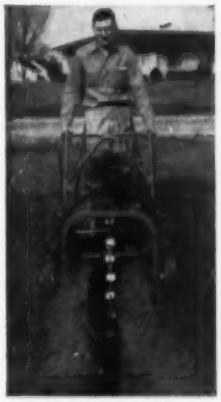

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and continued into the appliance or device. You see, having installed some 100,000 or more in my 20 years in this field, I find that all 110/125- volt receptacles are polarized; i.e., by a large T slot and a small T slot that is the live side, or by an I, large in size, and a small I which is the live hot wire.

I believe that the N.E.C. stipulates that the hot or live wires should be switched and not the white or neutral wire. Does it apply to switches in small appliances? Why not have the Underwriters have the manufacturers install polarized caps like Cat. No. 6764 or 6796 Hubbell 28 catalogue on all lamps, irons and switch the live wire and not the neutral, as occurs with the present caps?—J.K.

A. Article 200 of the code covers the polarity identification of systems and circuits. In general this Article requires, with some exceptions, that an interior wiring system shall have a grounded conductor which is identified by a white or natural gray covering. Such a grounded, identified conductor must be connected to the screw shell of lampholders since it safeguards the personal injury hazard against shock which exists when the screw-shell is live. Section 3801 prohibits the use of a switch in the grounded conductor of a circuit unless the switch simultaneously disconnects the ungrounded conductors of the circuit. This rule also is significant, since a circuit not in use, will have 50% or more of the live conductors disconnected from the source of supply. These code provisions appear to apply to circuits and not to the devices connected to the circuit. I quote the following:

"Section 2008-b. Utilization Appliances. The terminals of utilization appliances need not be marked to indicate the proper connection to the grounded conductor. If the terminals of utilization appliances, of which single-pole switches form an integral part, are marked for identification, the terminal connected to the switch shall be the unidentified terminal."

"Section 2008-c. Portable Appliances. The terminals of portable appliances need not be marked for identification."

It appears evident from the foregoing rules that the code does not intend to apply the general provisions of Article 200 to the general run of appliances, and apparently there is no code violation in the cases which you have called to our attention. Insofar as polarity at

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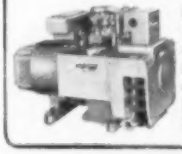

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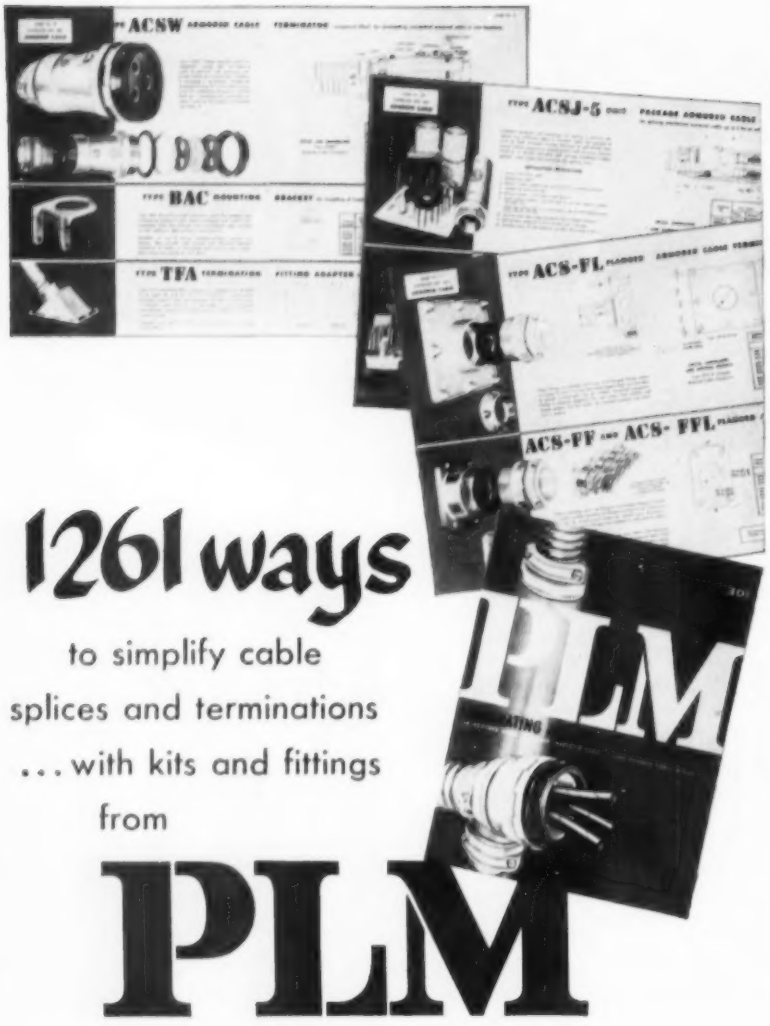

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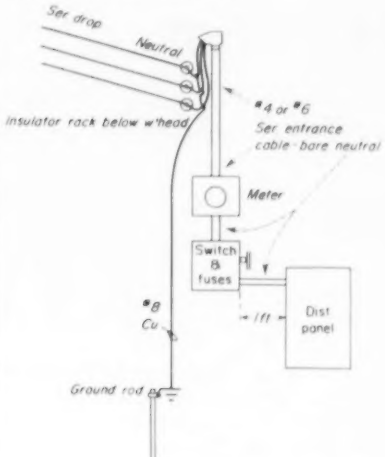
the appliance is concerned, there appears to be no question of hazard as is evident with the screw-shell lampholder. There is however a question, as you point out, which concerns the desire to place the switch in the unidentified or live conductor of the appliance.

As you state, all of our 125-volt small appliance receptacles are polarized and it appears there would be no hardship involved if portable lamps or devices with switches were equipped with polarized cord caps, so that the screw-shells of sockets would be connected to the grounded conductor and switches would be connected in the live conductor. A code rule to this effect would tend to eliminate a question of inconsistency which now appears to prevail. Today we have several million polarized receptacles installed in residential occupancies and I doubt if a fraction of one per cent is used to obtain polarity.—B.A.McD.

Service

Q. *Is the installation shown below according to the code? What if the service entrance cable were replaced with conduit? What if the service racks were above the weather head?—T.D.S.*



A. We shall analyze this installation step by step. The insulation of the service conductors is covered in Section 2303. In paragraph "a" the grounded service conductor is permitted to be without insulation covering if the service conductors have a nominal voltage to ground of not more than 300 volts. Basically this would mean that the service neutral could be a bare conductor from the point where it connects to the utility

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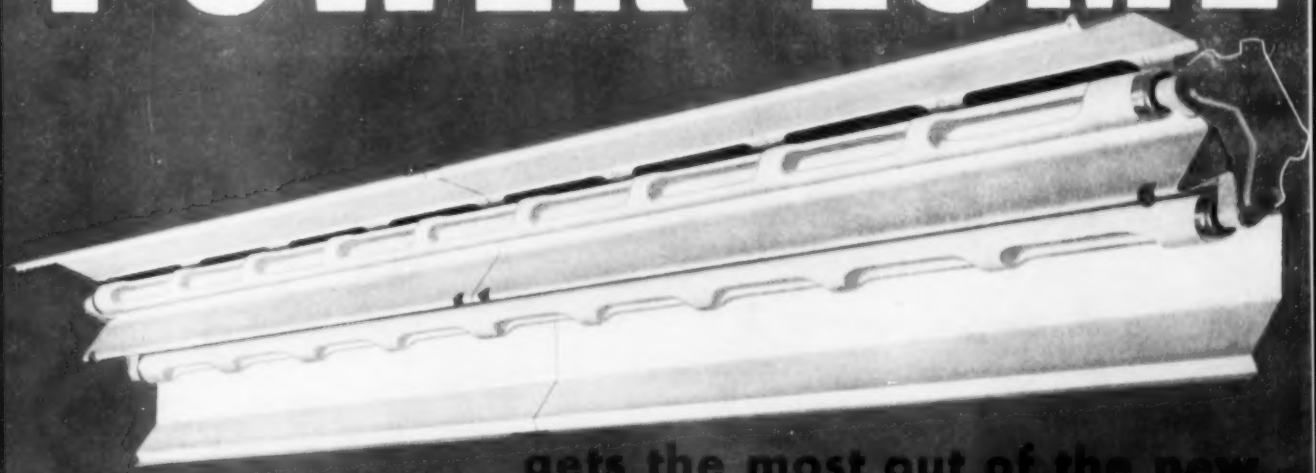
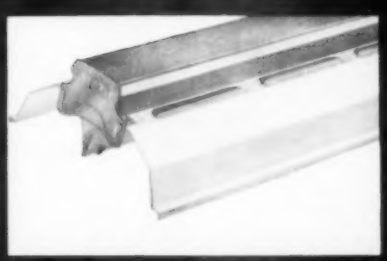


gets the most out of the new

POWER-GROOVE LAMPS

POWER-LUME F



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Distributed exclusively through electrical wholesalers.

Delivers **TWICE** the amount of lumen output per foot of lamp length!

Today's big news in industrial lighting. 2 outstanding Wheeler units — Power-Lume F and Power-Lume V — specifically designed to utilize *fully* the extra illuminating power of the new Power Groove Lamp. Both fixtures are designed for all medium to high mounting applications . . . provide more comfortable seeing, cooler lamp operation, thanks to Wheeler's unique diffuser apertures that direct MORE than 20% of the light upwards.

POWER-LUME F (porcelain reflectors) are ideal for use where rough work is being performed and shielding is unimportant. Where reduced brightness is required, Power-Lume F with aluminum reflectors does the job best.

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NEWEST UNIT IN WHEELER'S "PACKAGE PLAN" LIGHTING

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275 Congress St., Boston, Mass.

New BLACKHAWK ALUMINUM "1-bite" benders slash bending costs 77%

Now your own men can easily make factory-like bends while you enjoy BIG SAVINGS!

Super-portable Blackhawk electric-powered hydraulic pipe benders *save up to 77%* compared to cost of manufactured ells! Pay for themselves in just 35 bends.

BLACKHAWK offers benders in ALL price and size ranges to meet every bending need!

NINE complete Blackhawk bending sets handle 1⅛" - 2" diameters thin-wall conduit — ½" - 4" diameters rigid conduit and pipe. Your choice of either lightweight rugged steel or new, featherweight aluminum construction.

MODEL	PUMP	DIAMETERS	PRICE
S-30A	Hyd. hand pump	1, 1¼, 1½, and 2" rigid conduit and pipe	$166.65
S-34	Hyd. hand pump	1¼, 1½, 2" thin-wall conduit	279.00
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New S-130 1-bite	Hyd. hand pump	½ - 2" rigid conduit and pipe	218.90
New S-132 1-bite	Electric-powered pump	½ - 2" rigid conduit and pipe	546.00
New S-137 1-bite	Hyd. hand pump	1¼, 1½, 2, 2½, 3, 3½, 4" rigid conduit and pipe	621.50
New S-138 1-bite	Hyd. hand pump	1¼, 1½, 2, 2½, 3" rigid conduit and pipe	522.50
New S-139 1-bite	Electric-powered pump	1¼, 1½, 2, 2½, 3" rigid conduit and pipe	803.00
New S-140 1-bite	Electric-powered pump	1¼, 1½, 2, 2½, 3, 3½, 4" rigid conduit and pipe	902.00

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BLACKHAWK MFG. CO., Dept. P-20107, Milwaukee 46, Wisconsin

Hydraulic pipe benders

Hydraulic Knock-Out punches

Hydraulic jacks 1½ to 100 tons

BLACKHAWK bends prove BLACKHAWK'S best!

company's transformers, or secondaries on the pole lines or secondaries in an underground manhole, etc.

However, it should be noted in paragraphs "c" and "d" of this section, that further limiting rules prohibit the use of the bare neutral if open individual conductors are used for service conductors. Thus for an overhead line the service drop must be a multi-conductor cable if a bare neutral is to be installed. The service entrance conductors, similarly, must be such a cable, or the individual conductors must be installed in a raceway, i.e., conduit, EMT etc., or it may be Type WP if on the exterior of a building.

Underground conductors are usually installed as concealed conductors, as a cable or in a raceway so that in general the neutral may be bare under the conditions specified in the above first paragraph.

It should be noted that the bare neutral applies generally to the service conductors. Therefore, the short 1-ft section shown extending from the service switch and fuses (the service equipment and termination of the service proper) cannot be used. This short section must have fully insulated conductors for all wires. The bare neutral type of service entrance cable is approved for only specific cases of feeder wiring and interior wiring as covered in Section 3382.

In this Section 3382, the bare neutral service entrance cable may be used to feed an electric

1. range, or
2. clothes dryer, or
3. domestic water heater.

It may also be used as a feeder from a service cabinet to supply other buildings; i.e., the service entrance conductors from a service distribution center to other buildings. This would of course include the service entrance conductor sections to these other buildings.

To install the bare neutral service entrance cable as permitted in the above paragraph, the following three conditions must be met.

1. The service entrance cable shall have a final outer covering consisting of non-metallic material.

2. The supply shall be alternating current not exceeding 150 volts to ground.

3. If supplying a domestic water heater it shall have the bare neutral conductor for use as a grounding conductor only.

The location of the insulator racks is governed by the fourth

CORROSION RESISTANT... NO PAINTING WITH ALCOA RIGID CONDUIT

If you have motors, controllers, switchgear and other electrical equipment in damp or corrosive locations, Alcoa® Aluminum Electrical Rigid Conduit can serve you better than any other material.

Because it resists corrosion, it never needs maintenance painting. It is nonsparking. It has Underwriters' Laboratories approval.

But there are other advantages, too . . .

It weighs about one-third that of steel. It's easier to cut, bend, thread, install. Factory-applied internal lubrication makes wire pulling easier and quicker.

It is nonmagnetic. You get up to 20% less voltage drop. Conductors can be separated, regardless of load.

It's surprisingly economical, too. Large sizes of Alcoa Conduit cost less than steel. When all factors such as maintenance and installation are considered, aluminum conduit in all sizes is competitive with steel.

Alcoa Aluminum Rigid Conduit is available throughout the country from warehouse stocks. Fittings, too, are readily obtainable, together with suitable Alcoa thread cutting and joint compounds.

Get the complete story from your nearby Alcoa sales office. Or use the coupon below to obtain literature and a generous sample of this better conduit.

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Please send literature on *Alcoa Aluminum Electrical Rigid Conduit* and a one-foot sample.

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Title _____
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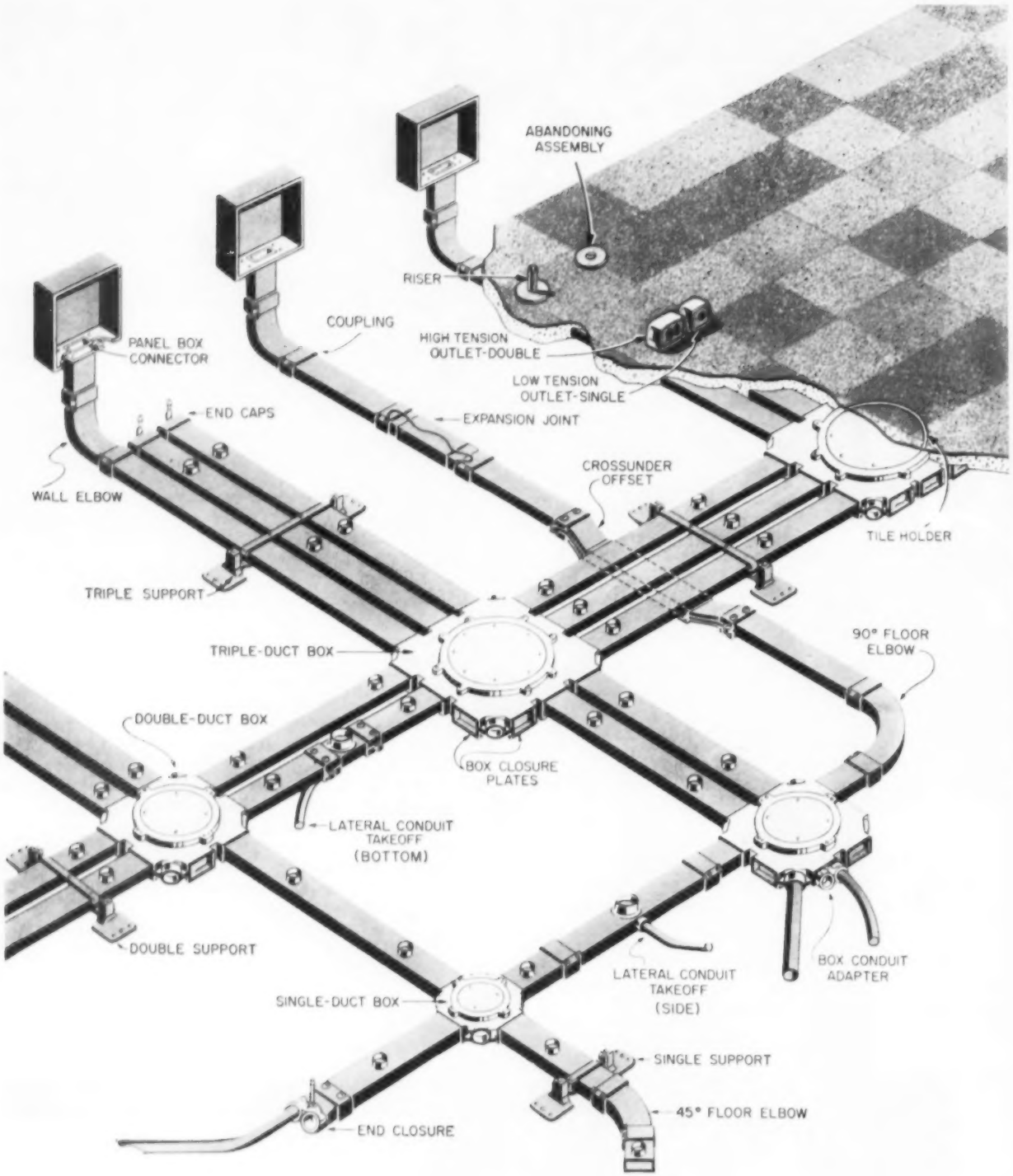

General Electric's new single-level steel underfloor wiring system provides a low-cost but efficient means of handling both feed and branch circuits. The simple, flexible design permits installation under any conventional floor layout without special adaptations.

These new, attractive surface fittings are available for both the new G-E single-level and the G-E two-level steel underfloor duct systems. The modern styling with low silhouette was designed especially to blend with the modern interiors of today's buildings.

General Electric offers you a . . .

NEW SINGLE-LEVEL STEEL

underfloor wiring system

For all types of floor constructions . . . can be used in fills as shallow as 2½ inches.

You have a complete choice of steel underfloor wiring systems from General Electric: The G-E cellular-steel floor system . . . the G-E two-level steel system . . . *and now General Electric's new single-level steel system.*

This addition to the G-E line of steel underfloor systems is designed for standard floor layouts where the greater flexibility of the two-level system is not required, or where fills are too shallow to accommodate other systems.

General Electric engineers have designed this system for easy installation—box and duct leveling is done quickly with a screw driver . . . slip couplings simplify duct connections . . . and wire pulling is a fast job because the galvanized ducts have smooth, organic-coated interior surfaces.

The standard-size steel ducts (3.357 sq. inches) provide adequate feeding and distribution capacity. Single, double, or triple runs of duct can be used according to the number of services needed.

All three General Electric steel underfloor wiring systems are listed by Underwriters' Laboratories, Inc.

When to Use the G-E Single-level System

Consider these factors before choosing an underfloor wiring system for your next project: a. Can a standard floor layout handle feeding and distribution? b. Is the floor fill less than 3½ inches? c. Can a single-level system fulfill future wiring requirements?

If so, you should consider this new General Electric single-level steel system. But, if you have other power requirements, find out about G-E cellular-steel floor and two-level systems. Whatever your needs, General Electric's experience and complete product line can provide your best answer. Call your nearest General Electric Construction Materials district office or write Section C77-101B, Construction Materials Division, General Electric Co., Bridgeport 2, Conn.

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GENERAL ELECTRIC

Low cost lighting maintenance with Revere hinged poles

Hinged poles, engineered to hold from 1 to 4 floodlights, are available in round, square and square-tapered models in heights from 18 to 30 feet.

Reduce the cost of relamping, cleaning and maintenance by using Revere hinged poles in your outdoor lighting installations. No matter who provides lighting maintenance, it's performed more quickly, safely at ground level. The cost of using boom trucks is eliminated. Hazardous and time-consuming use of long ladders is avoided. First cost of Revere hinged poles is no more than ordinary light poles.

From a quality standpoint, Revere hinged poles are built for rugged duty and will withstand wind loading of 100 m.p.h. Check with your electrical supplier on other cost and quality advantages of Revere hinged poles.

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sentence of Section 2337. It should be noted that this rule applies specifically to the point of connection. In your case since the rack is below the service head the point of connection of the service entrance conductors to the service drop conductors is below the service head.

It should be pointed out that it is possible to have the service rack above the service head and still comply with this rule. In this case the service drop wires are tied on to the terminal rack with enough wire left on each conductor behind the tie point to make the connection to the service entrance conductors at some point below the service head.

The No. 8 copper grounding conductor is a Code violation. Section 2592 permits a No. 6 as the minimum size grounding conductor.—B.Z.S.

Wiring for a School

Q. *A large new addition was added to the old high school building in our city several years ago during the consolidation of school systems. The old building was served with a single phase, 3-wire service and the new addition was provided a separate service consisting of 4-wire, 3-phase. They now wish to enlarge their Industrial Arts Department by taking over a portion of the basement of the old addition and we have been engaged to extend a 3-phase feeder from the new addition to this new room planned for the old building. We have just been told that this would be a violation of the code and that a feeder for this new room would have to come from the old service, making it necessary to completely replace the existing service with a new 4-wire, 3-phase service in view of the need of 3-phase current in this room. Inasmuch as it was wrong in the first place to serve the new addition with a separate service, would it not be O.K. to extend a feeder from that new service on into the old building in view of the fact that there is adequate capacity in the new service to supply this additional load?—P. F. C.*

A. If the new addition is a separate fire division from the existing older building, that is if there is a continuous masonry wall erected from the lowest floor through the roof of the buildings between the two and if all openings

Another new development using

B.F.Goodrich Chemical *raw materials*

Installation of Triplex wire manufactured by Southwire Company, Carrollton, Georgia.

Here's a rugged outdoor performer...

TRIPLEX

insulated with

GEON

IT'S TOUGH, weatherproof, and maintains its exceptional electrical properties with age—that's why insulation of Geon polyvinyl materials is offered on Triplex line wire and service drops.

This wiring takes pulling over crossarms, dragging along the ground and the other punishment that goes along with outdoor wire installation. The physical properties and aging characteristics exceed all accepted standards for this application.

The insulation of Geon polyvinyl materials shuns the sun, oxygen and ozone attack. In industrial areas, it withstands oils, greases and the effects of air-borne acids, alkalis and other chemicals. What's more, it resists flame, will not support combustion and has good flexing properties. The wire is light, small in diameter, free stripping, easy to handle and competitively priced.

For the greatest lifetime economy, choose wiring with this exceptional covering. For more information, write Dept. GF-5, B.F.Goodrich Chemical Company, 3135 Euclid Avenue, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

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B.F.Goodrich GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

NORTHWESTERN University

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By using the Electro Silv-A-King "SKYLOUVER" in Chicago and the "20/20" fixture in their Evanston school, they were able to reduce maintenance costs and achieve an attractive uniformity in appearance regardless of location or mounting arrangement . . . and, at the same time, provide the correct level of comfortable, glare-free illumination for the various seeing tasks in every type of room.

LECTURE ROOM—EVANSTON Six rows of 4-ft. 2 light "20/20" units, single stem mounted on 4-ft. centers maintain 90 foot candles. Louvers are spaced equi-distant for more attractive appearance.

LIBRARY—DOWNTOWN This walnut paneled library seats 300 people. Ninety-six, thin 4-lamp "SKYLOUVER" units, with translucent styrene louvers, deliver 60 footcandles of "just like daylight" illumination.

Electro-Silv-A-King fixtures are also used in offices, laboratories, television studios, corridors, etc., in various buildings on both the Evanston and Chicago campuses.

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Because the Electro-Silv-A-King line offers an unprecedented variety of fine quality fixtures now being used in many of the nation's outstanding schools. There is one that will meet your every requirement for performance, appearance and value.

Write today for your free Specification and Data Catalog illustrating and describing the complete line.

Electro Silv-A-King Corporation

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DESIGNERS AND MANUFACTURERS OF THE FINEST IN LIGHTING

through this wall are protected by Class "A" fire doors, the installation of a separate service for the new addition was not a code violation. If, on the other hand, these two buildings were not separated by a standard fire wall, the use of two separate services would, of course, have been a definite code violation. If the 3-phase load now being planned for this new Industrial Arts Department to be located in the old building will constitute the only 3-phase load in that building and if the two buildings are separated by the aforementioned fire wall, the extension of a 3-phase feeder from the service equipment in the new building into this room in the old building would be in conformance with paragraph c. of Section 2301, which does permit an additional service to a building if that second service is used solely for a different class of use. Section 2302 does provide permission to serve one building through another building where such buildings are under common occupancy or management.—G. R.

Housing Project

Q. *Our bid on a fair-sized housing project for the electrical work was recently accepted. Each of the houses on this project are to have an ornamental light mounted on a 2½-in. conduit set in a concrete base in both the front and rear yards. The specifications on which we bid call for a 2-conductor type UF wire to be run from the distribution panel in the basement of each house to each of these lights with switch control points mounted at the front and rear doors. We believe we are entitled to an extra on this as we feel a 3-wire conductor is necessary in order that each of these lighting standards be grounded to the neutral bus. Does not the code require such standard to be grounded? —N. B.*

A. Yes, the code very definitely requires under Section 2542 the grounding of all noncurrent-carrying metal parts of fixed equipment which are likely to become energized if they are within reach of a person standing on the ground. Inasmuch as a 2½-in. conduit set in a concrete base will normally have rather high resistance to earth, the code under Section 2551 requires that a path to ground from this steel pipe shall have impedance sufficiently low to limit the

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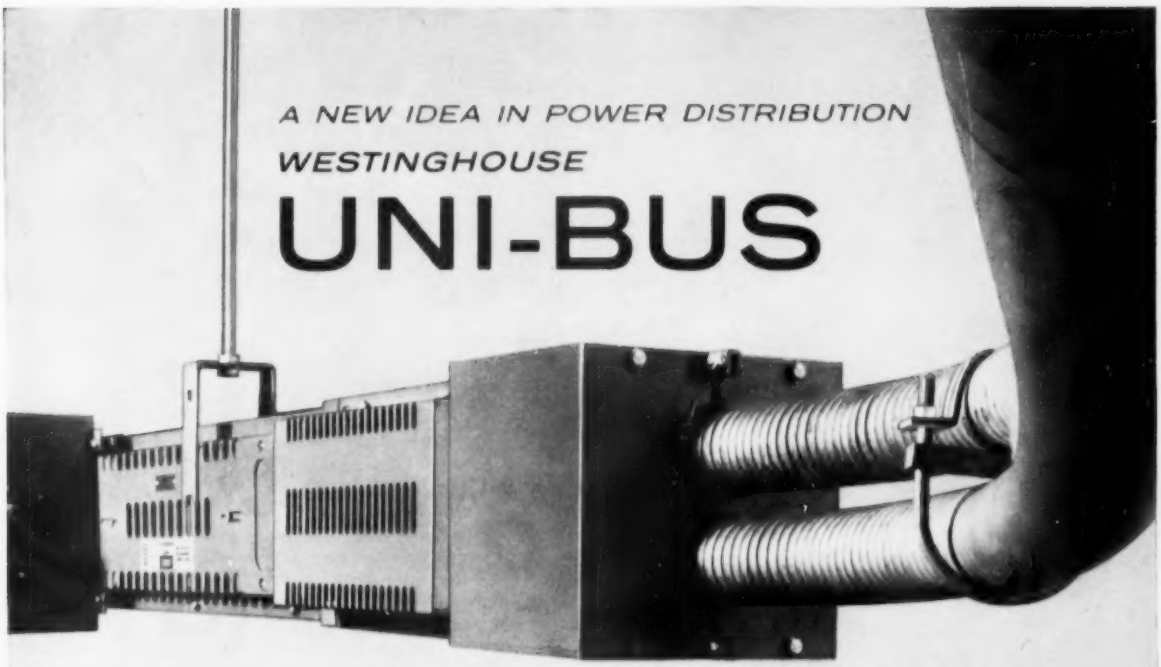
WESTINGHOUSE

UNI-BUS

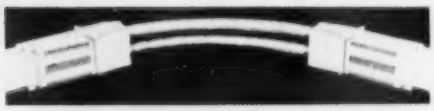


better because it's downright easy to use...

No busway is easier to use than new Westinghouse Uni-bus. One reason is the exclusive flexible connector that does away with all special fittings. And it simplifies layout and installation because no exacting field measuring is required.

One more reason Uni-bus is your best buy is the clip-on hangers which literally snap into place. And Uni-bus is lighter than any other busway.

Uni-bus is absolutely safe to use. It is impossible for personnel to touch live parts through plug-in openings. For more information, call your Westinghouse distributor, or write for booklet, B-7015, Westinghouse Electric Corporation, P. O. Box 868, 3 Gateway Center, Pittsburgh 30, Pennsylvania. J-30238



YOU CAN BE SURE...IF IT'S

Westinghouse

PLUG-IN LOW-IMPEDANCE BUSWAY

Electricians finish work on the SPANG HD installation prior to pouring of concrete. SPANG HD is highly resistant to corrosion in damp locations.

Architect: Schmidt, Garden & Erikson, Chicago, Ill.
Builder: Ragnar Benson Inc., Pittsburgh, Pa.
Electrical Contractors: Howard P. Foley Co., Pittsburgh, Pa.
Patterson-Emerson-Comstock, Inc., Pittsburgh, Pa.
SPANG Distributor: Graybar Electric Co., Pittsburgh, Pa.

88 miles of SPANG® Conduit protect wiring

SPANG HD is uniform in every respect, bends easily and accurately on the job, saves installation time.

SPANGLEAM EMT is used for short runs and lighting. Smooth interior finish makes wire pulling easy.

The Schools of the Health Professions Building houses classrooms, offices, labs, student center, library, auditorium, laundry and dining facilities. SPANG Conduit protects the wiring throughout the structure.

at University of Pittsburgh's new medical building

SPANG HD and SpanGleam EMT specified because of quality and service

The new Schools of the Health Professions Building at the University of Pittsburgh houses the Schools of Medicine, Pharmacy, Dentistry, and Nursing. SPANG HD Conduit and SPANGLEAM EMT protect the wiring throughout this modern 15-million dollar, 13-story structure. SPANG was used by the contractor, Ragnar Benson, Inc., because of the service required on a job of this size and the high quality of SPANG Conduit.

The Spang HD Installation . . . Electricians installed 342,920 ft of SPANG HD Galvanized Conduit for general electrical service in the building. The excellent corrosion-resisting characteristics of the SPANG HD finish permitted its use in damp areas. With the exception of the laboratories, all conduit is covered.

"SPANG gave us good delivery," said Mr. J. D. Brown, engineer for Patterson-Emerson-Comstock, Inc. "We got what we needed when we wanted it and the way we wanted it."

The SpanGleam Installation . . . For short runs and lighting, 126,000 ft of SPANGLEAM EMT were installed. "SPANGLEAM is a top-quality, first class product," said Mr. Brown. "There was no chipping or peeling of the finish, and the blue plastic tape bundling on SPANGLEAM is an important safety factor in handling the conduit."

You get Top Quality with Spang . . . because SPANG Conduit is *quality-controlled* throughout its manufacturing and is carefully inspected before shipping. You'll find SPANG will save you time on the job, make installations easier, more profitable. If you've never tried SPANG Conduit, make it a point to use it on your next job. Your local SPANG Distributor will be glad to serve you.

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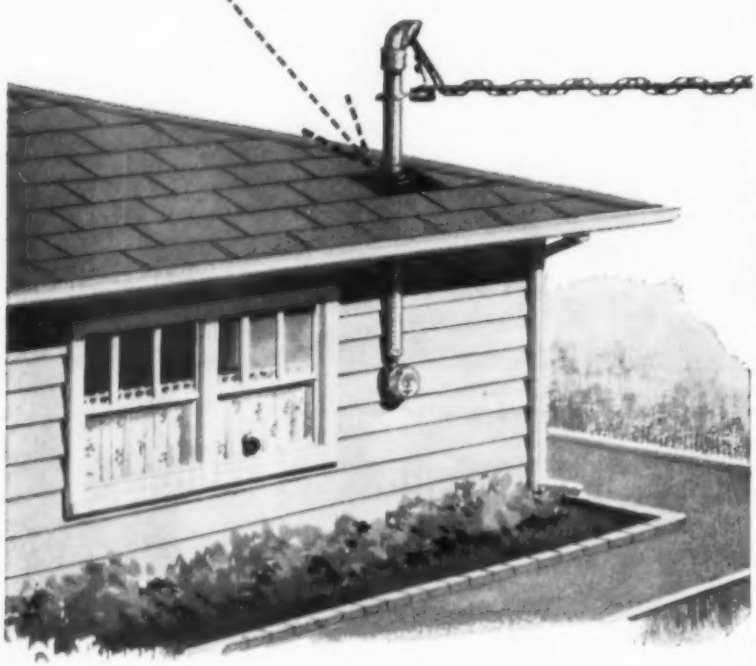
SYNROFLASHING
protects this roof from moisture leakage... mast vibration damage



All Blackhawk service entrance mast kits feature this new synroflashing unit. It's a neoprene roof flashing unit that absorbs mast vibrations in the collar area. The mast can't work loose, damage shingles or give moisture a place to seep in.

Synroflashing is weather proof and weather resistant. Won't crack, peel or rot no matter what the atmospheric conditions. Synroflashing units on the Blackhawk Service Entrance Mast will give long years of dependable, trouble-free performance. Units are easily installed. They simply slip over the pipe and are pushed down to the roof. Shingles fit over it easily. Synroflashing units are available for 2" and 2½" pipe.

Blackhawk service entrance masts, with Blackhawk's famous Slip-Fitter head and new Synroflashing, can be sold as complete kits or as separate fittings.

Blackhawk Industries, Dubuque, Iowa
Where the new ideas come from

potential above ground and to facilitate the operation of overcurrent devices in the circuit. To fully comply with this provision, it is necessary that the resistance to earth be sufficiently low to assure the opening of the overcurrent protective device used to protect the circuits extending to these outdoor lights, and as they will in all probability be rated at 15 amps, this would require the resistance to be not more than 6 ohms, which is much less than can normally be attained with a grounding rod or normal soil contact with a metal standard, making it economically necessary in most instances to run the third wire to this standard.—G. R.

Junction Boxes

Q. *According to Article 3749d an auxiliary gutter with 200 MCM cables entering shall have a minimum width of 4 in.*

If a junction box is placed at the end of the gutter with four-200 MCM cables entering in 3-in. conduit, according to Article 3736, a box will be needed of 18-in. width. Is this correct?—D.T.S.

A. Yes, you are correct. However, I believe your reference in the second paragraph should be to Section 3708 instead of Section 3736.—B.Z.S.

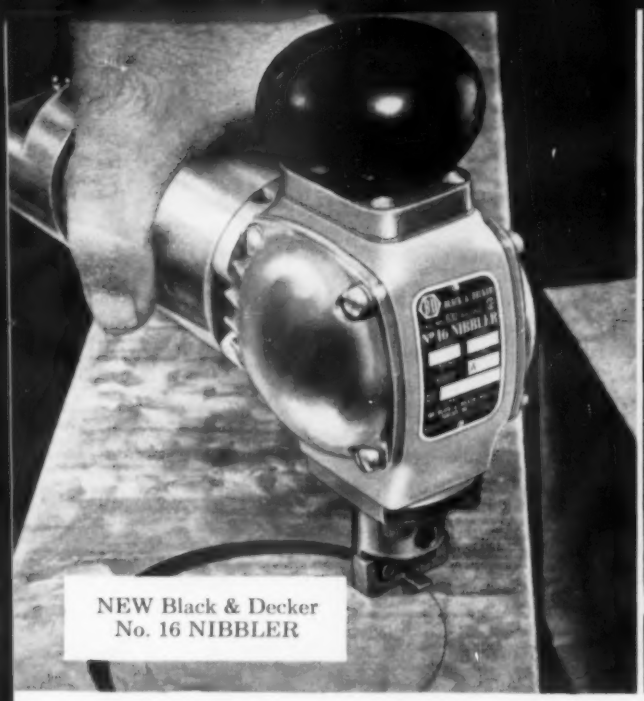
440-Volt Fuses—220-Volt System

Q. *I would like to ask a follow-up question regarding the 440-volt fuses on a 220-volt system, answered in the April issue on page 262.*

Section 4402 states that the disconnecting means shall be a motor-circuit switch, rated in horsepower, or a circuit breaker. I believe this may be accepted in the case of motors rated 2 hp or less, but suppose the motor was 30 hp. Wouldn't there be a violation of the Code, inasmuch as the switch would be rated for 30 hp on 440 volts where it actually was being used for 30 hp on 220 volts?—C.P.M.

A. For the benefit of our readers, we are repeating our answer to the code question, on the above subject, published in the April issue of EC&M, as follows:

"A. Table 34 of Chapter 10



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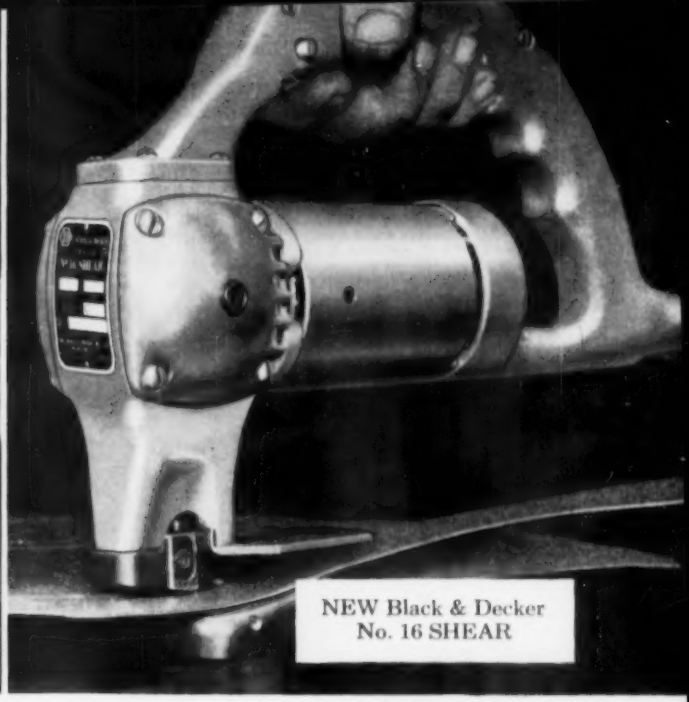
No. 16 NIBBLER



NEW Black & Decker
No. 16 SHEAR

Two New B&D Tools speed up sheet metal jobs!

Faster, lighter, easier handling, POWER-BUILT and packed with features

Whether you need the speed of shears or the more precise performance of nibblers—you'll find a lot to like in the new Black & Decker No. 16 Shear and No. 16 Nibbler.

By actual test, they're faster and longer-lived than competitive tools. Their lighter weight means easier handling. Their centrifugal fans give cooler running. Each has exclusive construction features to stand up under the shock of sheet metal cutting.

Try these new tools at your nearby Black & Decker distributor. There's a No. 12 Shear, too, for heavier work. For full details on new features, write to: THE BLACK & DECKER MFG. CO., Dept. 1210, Towson 4, Maryland. (In Canada: P. O. Box 278, Brockville, Ontario.)

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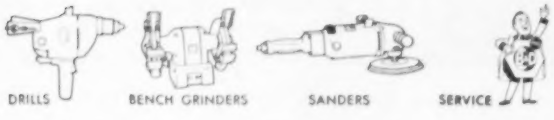
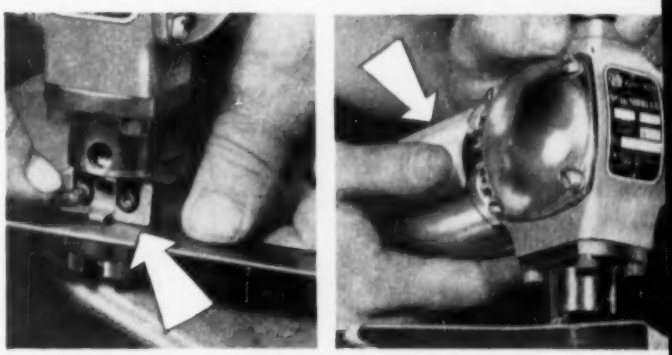
Quality Electric Tools—Power-Built to set the pace.





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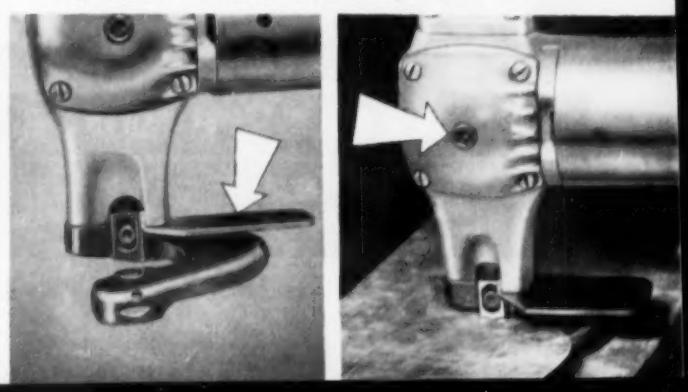

Frahm® Resonant Reed Tachometer

Operates simply by being held against or mounted on the machine under test. Measures vibrations per minute as well as rpm from 900 to as high as 100,000. Long life . . . no moving parts.

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The range of speed measuring instruments available at Biddle gives you a complete selection from resonant reed to centrifugal and chronometric types. Bulletin 35-ECM includes a Handy Selection Chart, and descriptions of all the tachometers in the Biddle line. Whether you want readings of instantaneous speeds, variations in speeds, or average measuring in RPM or FPM, let us recommend the proper instrument for you. "It's easy to be sure—Just be sure it's from Biddle."

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D-617

JAMES G. BIDDLE CO.

- ELECTRICAL TESTING INSTRUMENTS
- SPEED MEASURING INSTRUMENTS
- LABORATORY & SCIENTIFIC EQUIPMENT

1316 ARCH STREET
PHILADELPHIA 7, PA.

covers the dimensions of N. E. Code standard cartridge enclosed fuses and the first column of this table covers the voltage. It is important to note the two voltage classifications as follows:

Not over 250 volts.
Not over 600 volts.

"This table indicates to me that a 440-volt fuse may be used on a 220-volt system but a 220-volt fuse could not be used on a 440-volt system. As a result, it would not be necessary to change the 440-volt fuseholders to 220 volts. This is a personal opinion which I believe the above mentioned table verifies."

The above general answer did not anticipate the situation which results, as covered by C.P.M., when a fused disconnecting switch is used as a motor-circuit switch rated in hp. A 30-hp motor at 220 volts is rated at 78 amps, and at 440 volts the rating is 39 amps. As a result, it appears evident that a 440-volt, 30-hp motor-circuit switch would not be able to interrupt the maximum operating current of a 30-hp motor connected to a 220-volt circuit. Reference to manufacturers' catalogues shows that a 3-pole fusible, 100-amp switch is rated 30 hp at 575 volts ac; and 15 hp at 230 volts ac. When such variable ratings appear on the nameplate, they must be observed and properly applied. While the provisions of Section 4402 do not associate hp rating with voltage, there is no question with respect to the observation of C.P.M. A 30-hp 440-volt motor-circuit switch could not be used as a disconnecting means for a 30-hp motor operating at 220 volts, without violating the Code requirements.—B.A.McD.

Logic of 10- and 25-ft Tap Rules

Q. *Section 2434 of the 1956 National Electrical Code spells out the exceptions to the locations of overcurrent devices. If the logic behind the 10-ft and 25-ft rules is to "write off" these short lengths of sub-feeders when a fault appears, then longer taps could logically be made where personal safety is not a factor. Kindly advise me on the theory or logic on this part of the Code.*—J.J.C.

A. As covered under the introduction, the purpose of the Code is the practical safeguarding

MOLDED CASE CIRCUIT BREAKERS

Magnetic only type ETI circuit breakers have convenient, externally located adjustment controls. Available in F, J, K, KL, L and M frame (3 to 800 amperes continuous ratings), 2 or 3 pole, 600 v a-c, 250 v d-c.

Only I-T-E gives you convenient external trip adjustment

In motor control and resistance welding applications, adjustment of protective devices to a required setting is important. One of the many features of the ETI circuit breaker is its convenient externally adjustable magnetic trip device. When it is required to adjust the trip to a finer degree, adjustment is made from the front of the breaker without interrupting service or encountering live conductors. The range of instantaneous trip adjustment means greater protection for motors and resistance welders. When a short circuit occurs, all poles open simultaneously. And enclosed terminals protect personnel, yet permit easy cable connections. All these extra values in I-T-E molded case circuit breakers are yours at no extra cost. Send for complete information or contact your nearest I-T-E authorized distributor.

I-T-E CIRCUIT BREAKER COMPANY • **Small Air Circuit Breaker Division**

19th & Hamilton Sts., Philadelphia 30, Pa.

IN CANADA: EASTERN POWER DEVICES, LTD.

of persons and of buildings from the hazards incident to the use of electricity. In order to satisfy this fundamental, basic minimum rules, considered necessary for safety, are formulated; and the degree of safety often is influenced by what is considered to be practical under field conditions of use.

The first sentence of Section 2434 expresses a fundamental rule covering overcurrent protection of conductors, which requires an overcurrent device to be located where the conductor receives its supply and is rated to protect the conductor within the current-carrying capacity established in Tables 1, 2, 1a, and 2a of Chapter 10. Compliance with this fundamental provides maximum protection against overloads and short circuits. While compliance is desired in all cases, field applications often arise where it is not considered practical to fully comply with the fundamental, and exceptions are made whereby the degree of safety is lowered in the interest of practical considerations. In other words, the circumstances involved are considered in the formulation of an exception.

In the case of the 10- and 25-ft tap rules covered by Section 2434, the logic behind these Code exceptions does not "write off" or fully discount the importance of the fundamental. In the case of the 25-ft tap, the conductors are protected from overload by the overcurrent device located at the load end of the tap; and short-circuit protection is obtained by the overcurrent device protecting the main. In the case of the 5-ft tap the current is likewise limited by overcurrent devices, and in some cases short-circuit protection may be obtained by the overcurrent device protecting the main. In both cases, however, the degree of safety established is not as high as that obtained when the fundamental is fully satisfied, and this is to be expected when an exception is made to a basic rule.

I do not agree that the logic or reasoning behind these two exceptions should be the occasion for further extension of the length of these taps. The 10- and 25-ft limitations are established on the basis of field installations which warrant such recognition. They are exceptions which should be applied only when the circumstances warrant same, and the limitations are fully satisfied. Personnel safety is not the only consideration involved, since the Code is also interested in safeguarding buildings and their contents from fire.—B.A.McD.

NOW
from Allis-Chalmers

Pushbutton stations designed to withstand even the most Corrosive Conditions

Here is one of the most practical developments to come along in recent years—Allis-Chalmers heavy duty pushbutton stations. From the phenolic BM-2498 enclosure to the Type 316 stainless-steel hardware, this line of pushbutton stations is exceptionally resistant to corrosive action of chemicals.

For the first time a proven-in-service, roll-action operator is completely protected by a rugged, corrosion-resistant enclosure. This assures longer, trouble-free operation in chemical plants, refineries, paper mills, or any industrial application where corrosive atmospheres normally cause pushbutton failures.

The complete line of Allis-Chalmers corrosion-resistant pushbutton stations includes:

- single or two-button units
- momentary or maintained contacts
- lockout attachment
- pilot lights

This newly designed pilot light has the same phenolic enclosure as the pushbutton stations, and is available as either single or double units. Wide angle lenses of flexible vinyl plastic have greater range of visibility, and are available in any combination of red, green, amber, blue, or white. Bayonet-type bulbs are used to resist shock. Primary voltages are to 550 volts; secondary voltage is 6.3.

For further details call your nearest A-C District Office or Distributor . . . or write Allis-Chalmers, General Products Division, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-5526

"HOLD DINNER . . .

I'VE GOT ONE MORE

He's your electrical distributor's salesman.
A customer calls, just about "quitting time."
So the salesman phones home: hold dinner.

"We need a 200 amp 3-pole SN fusible safety switch," the customer explains. "It's got to be type-A. We're stopped cold till we get one. How soon can you deliver?"

Right now, the salesman says. He delivers.

Pin a medal on him? No, that's his job – service.
He's there when you need him.

Your electrical distributor saves you money when he helps you avoid delays . . . Keep him in mind next time you order.

ELECTRICAL WHOLESALING

A McGRAW-HILL PUBLICATION

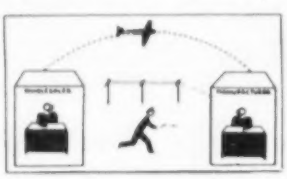
The only magazine devoted exclusively to the interests of the electrical wholesale distributor

---

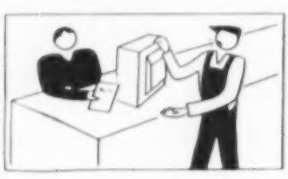
Your electrical distributor offers you these services:

His hundreds of purchase orders keep a flow of thousands of different products rolling from manufacturers into his warehouse the year around.

By airmail, telegraph, telephone, the distributor keeps in touch with the many manufacturers whose lines he stocks, to expedite his shipments to you.

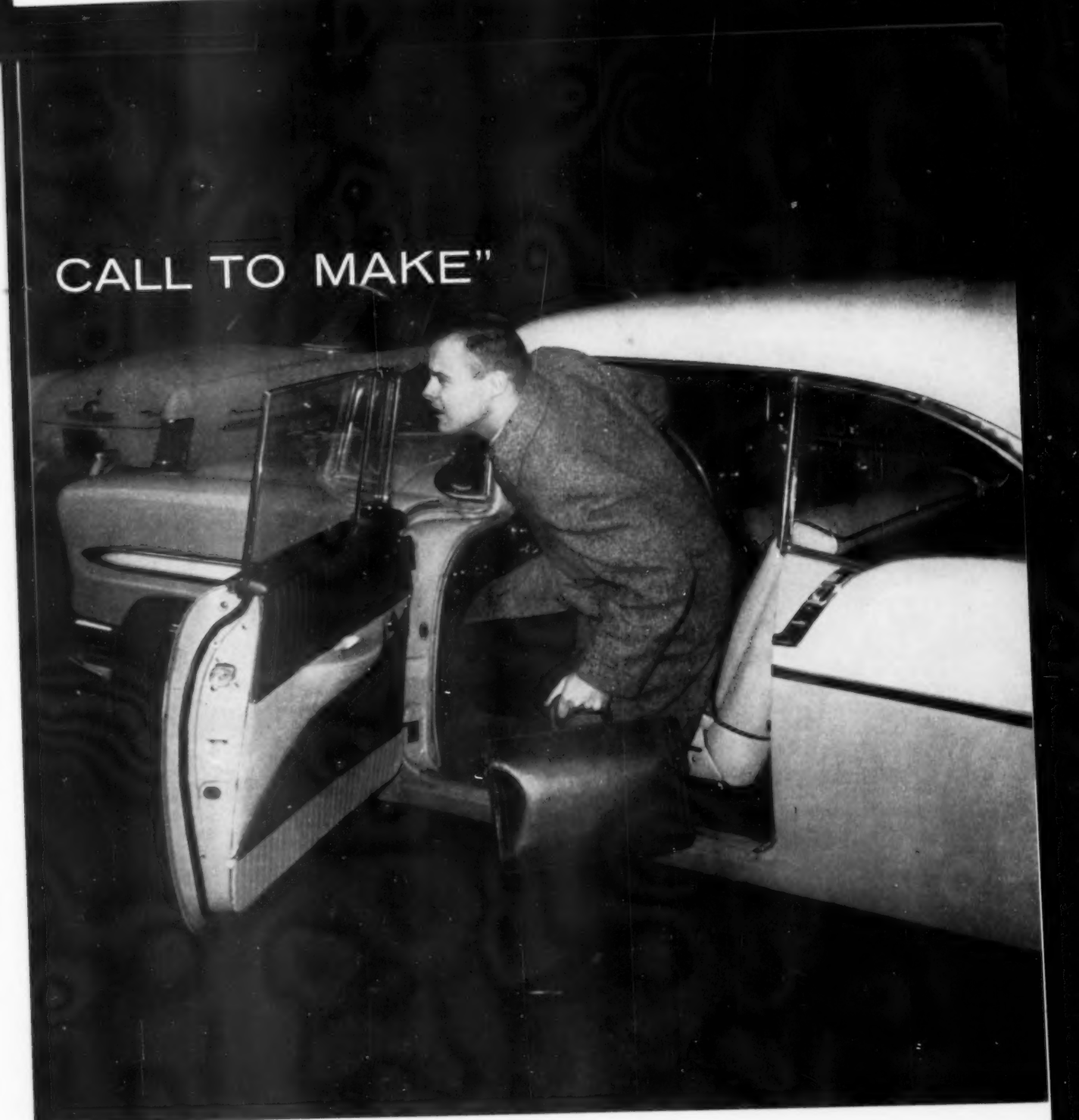


Regardless of how the distant manufacturer ultimately will compensate him, the distributor adjusts claims, returns goods, issues credits.



He trains and maintains a staff of salesmen who know the products required by the industry – where, how and when they are used.

CALL TO MAKE"



He assembles into single shipments the products of factories near and far, in sizes, types, and quantities the user needs.

He maintains a warehouse from which you receive swift, economical delivery of a vast variety of products, plus staggered storing for specific jobs, as needed.

His counter and telephone service require trained men who know the hundreds of products handled, their uses, codes and ruling in effect locally.

Practical Methods

Lighting, with Air Conditioning

TROFFERS

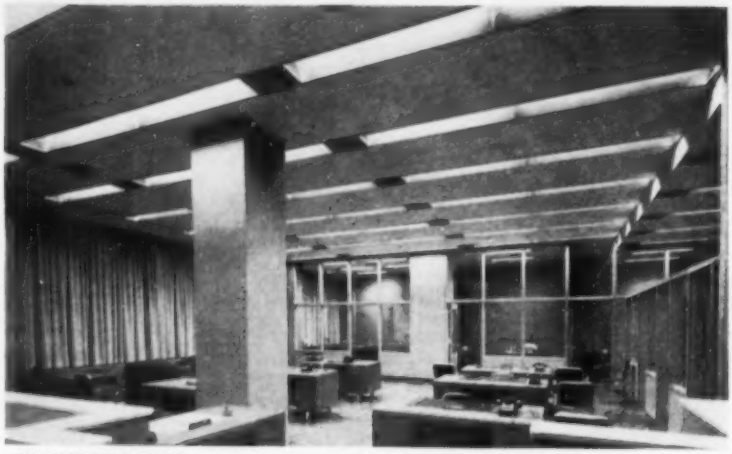
A unique installation of lighting fixtures which are an integral part of the air conditioning system, is a feature of a new Dallas bank. Fixture experts worked with the bank's architects and engineers to combine lighting and air conditioning systems without sacrificing the quality of either. The results were aluminum designed troffers, with special vents and plates serving to draw exhausted air into the ceiling plenum. In areas where ducts located above the ceiling made total recessing of troffers impossible, fixture engineers came up with another solution. This consisted of a fixture with a 3-in. deep steel collar and a Dentil pattern cut into each side of troffer providing additional ventilation.

In areas where long continuous rows of troffers were installed in large bank areas, such as the bookkeeping department, only troffers at the end of each row were vented.

A simplified installation method was developed. Every troffer in the building was installed by attaching the "U" support straps to each plaster frame before the frame was tied into the ceiling. By doing this the plaster frame assembly required no spacers since the "U" support straps maintained the correct width and also eliminated extra tying.

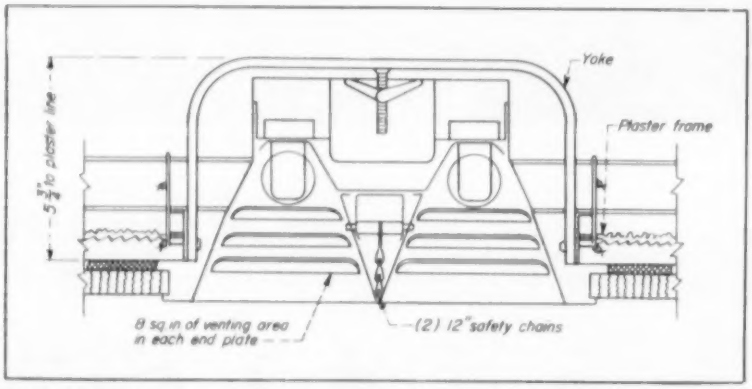
In the principal bank areas, alzak aluminum low-brightness troffers were used. The alzak process puts a transparent aluminum oxide coating on the metal, which gives it a highly reflective, easily maintained finish. This fixture uses 40-watt, 60-in., low-brightness lamps, and continues to maintain an average of 50 fc. Throughout the rest of the bank's 35 floors of rental area, louvered alzak aluminum troffers were installed, using two 40-watt, 48-in. rapid start lamps. They provide an average maintained level of 65 to 70 footcandles.

Electrical engineers who designed the lighting for the Dallas Republic National Bank Building were Zumwalt and Vinther of Dallas. Fixture manufacturer who provided and designed all the fixtures for the job was Curtis Lighting, Inc., Chicago, Illinois.

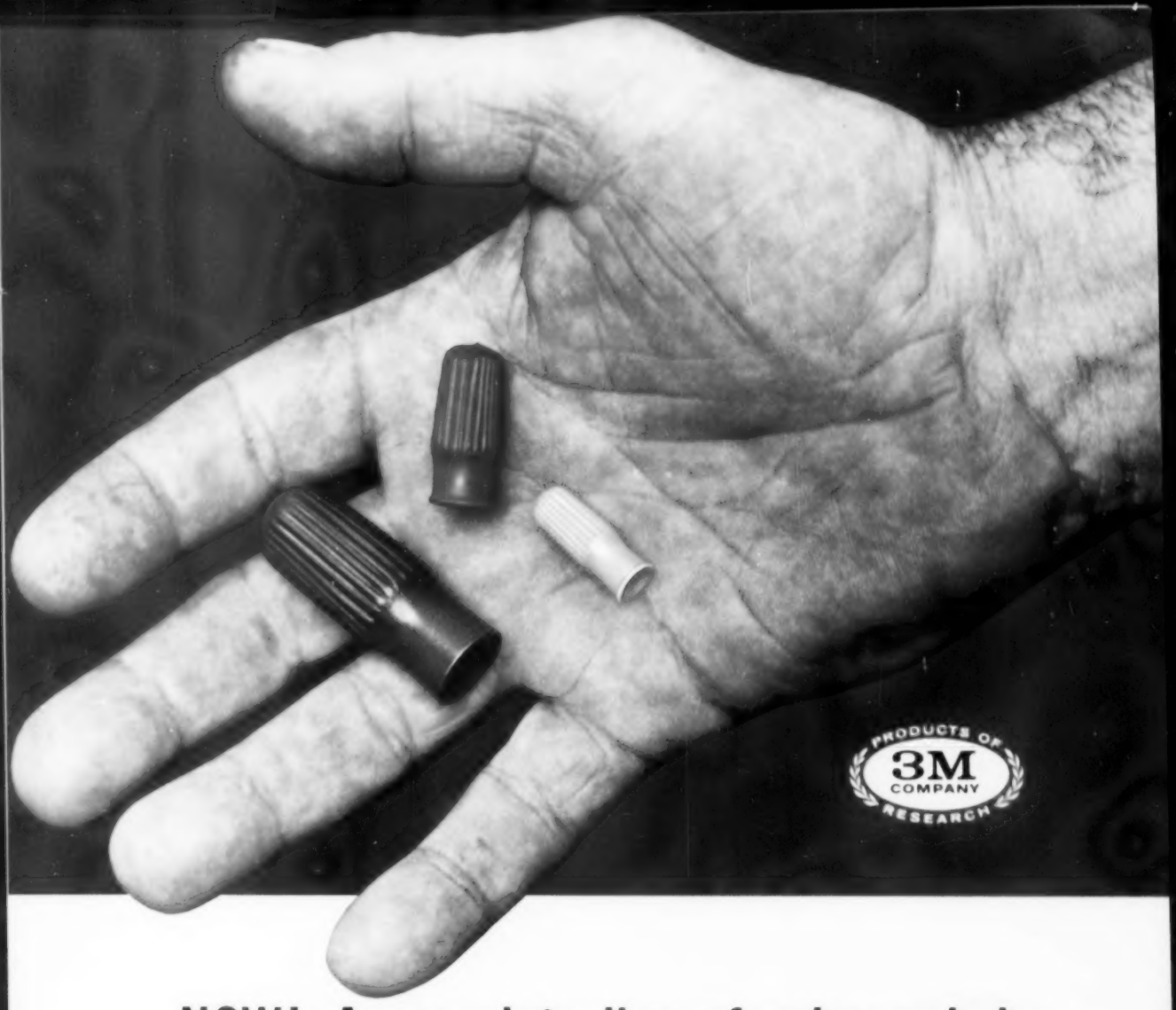


CEILING TROFFERS in the time credit department of the bank show how fixtures were adapted to the exhaust cycle of the air conditioning system.

BANK'S LIBRARY where ducts located above ceiling made recessing impossible. Fixture engineers developed 3-in. deep steel collar on fixture with a Dentil pattern on each side to draw in air.



SUPPORT STRAPS, "U" shaped, are attached to each plaster frame before frame is tied into the ceiling.



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SCOTCHLOK Electrical Spring Connectors

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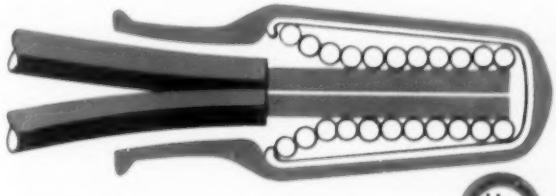
BRAND

Strong . . . the tightest gripping electrical wire connectors you can use. *Fast* . . . just "screw" them onto the wires . . . no special tools . . . no fumbling . . . *pre-insulated*. Reinforcing steel shell gives extra strength; prevents wire break-through. And you know your splice is tight because it feels right!

"live" Spring Action!

The strength is in the spring!

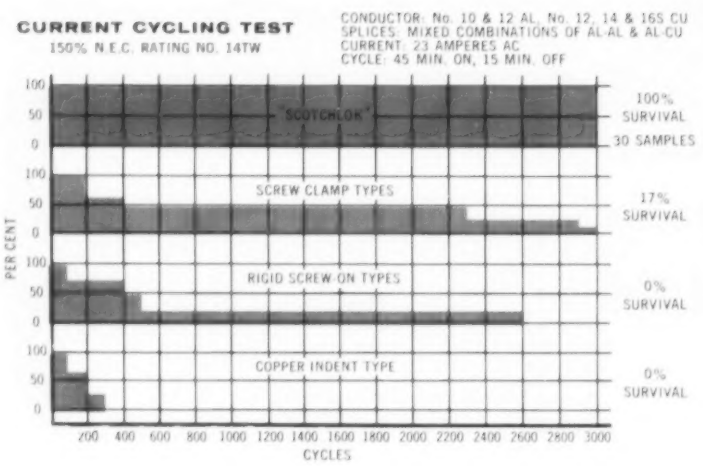
"SCOTCHLOK" Connectors grip wires with a "live" spring action that won't let go. Connection is vibration-proof . . . holds tight regardless of thermal or mechanical change.



See FREE SAMPLE OFFER on next page

PROOF! "SCOTCHLOK" outperforms all other connectors!

THIS CHART SHOWS the results of endurance tests run on samples of four different types of connectors. Samples were tested on conductors #10 & #12 AL; #12, #14 & #16S CU using mixed combination splices of AL-AL & AL-CU. When subjected to repeated current cycling, only the "SCOTCHLOK" with *live* spring action survived *all* the tests *all* the time without loss of grip or conduction efficiency.



Check these "SCOTCHLOK" Advantages:

- Just 3 sizes needed for *all* common connections.
- Unbreakable vinyl insulation doesn't dry out, chip, crack.
- Steel shell spring-housing prevents cut through.
- Live spring action prevents thermal loosening.
- Triangular shape for easy turn-on application . . . no tools needed.
- Long, conforming skirt protects wires, prevents flash-over.

Send for FREE SCOTCHLOK Samples

REG. U.S. PAT. OFF.

BRAND

SEE FOR YOURSELF how tight the grip . . . how permanent the holding power. Use this handy coupon. Your samples, with complete information, will be sent by return mail.

CLIP AND MAIL *TODAY!*

(M)

ELECTRICAL PRODUCTS DIVISION
ADVERTISING DEPARTMENT
MINNESOTA MINING AND MFG. CO.
ST. PAUL 6, MINN.

Please send me, without cost or obligation, samples of "SCOTCHLOK" Brand Electrical Spring Connectors types R, Y, and B, together with application and use information.

NAME .....

COMPANY .....

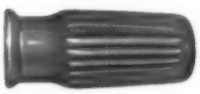
ADDRESS .....

CITY ..... ZONE ... STATE .....

MAIL COUPON TODAY

Now three types to meet every need:

TYPE Y: FOR FIXTURES. Handles wire range from No. 12 to 18 AWG solid and stranded.



TYPE R: FOR GENERAL CIRCUIT CONNECTIONS. Wire range from No. 10 to 16 AWG—solid and stranded.

TYPE B: FOR H. D. INDUSTRIAL APPLICATION. 6 to 12 AWG solid and stranded. The BIG connector for the BIG jobs.

Made by the makers of

REG. U.S. PAT. OFF.

SCOTCH

BRAND

No. 33 ELECTRICAL TAPE

"SCOTCHLOK" Brand Connectors belong to the same family of dependable electrical products as famous "SCOTCH" No. 33 Electrical Tape.

The terms "SCOTCH" and "SCOTCHLOK" are registered trademarks of Minnesota Mining and Manufacturing Company, St. Paul 6, Minn. Export Sales Office: 99 Park Ave., New York 16, N.Y. In Canada: P.O. Box 757, London, Ontario.

PRODUCTS OF 3M COMPANY RESEARCH

ILLUMINATION is provided by fluorescent fixtures mounted against white ceiling. Light is directed downward and is diffused towards sides by aluminum "Honeylite" grids, giving shadow-free illumination.

Continuous Ceiling Lighting

LIGHTING

Installing a lighting system to light 10,000 sq ft of drafting room space can present quite a problem, especially when the management of the building decides that no drafting lamps will be used. A system was needed that would be low in surface brightness, as devoid of shadows as possible, and still conform to the contemporary style of the building.

Above the 9-ft ceiling only 1 ft 7-in. of space was available for air conditioning ducts, lighting fixtures, public address and music system, plus various other mechanical and electrical equipment. Many types of lighting fixtures were considered, including recessed troffers, surface fixtures, and various styles of overall ceiling lighting. Taken under consideration at this time also was relamping, maintenance, and number of footcandles that would be provided.

After due consideration, the Bank Building and Equipment Corp. officials, the architect, John A. Campbell, the chief electrical engineer, Frank R. Niederkorn, with the electrical contractor, John Ledbetter and Company, decided on Hexcel "Honeylite" ceiling. It was composed of 2-ft by 4-ft panels of ½-in. hexagonal aluminum cells. The small cells of the honeylite diffuser provide a 45° cutoff angle. The texture and finish of the aluminum give the ceiling a very low brightness. After the ceiling slab was painted white, the fixtures were attached to Unistrut channels and 40-watt rapid start fixtures were mounted on 16-in. centers in 16-ft continuous rows.

In order to break up the monotony of the continuous ceiling, plaster bands were constructed at each column. In operation for six months, the ceiling provides an average reading of 100 footcandles. Because of the shadow-free illumination their main objective was accomplished without resorting to drafting lamps.

Obstructions Bypassed With Metal Cable Troughs

WIRING

Major reductions in installation time, also in materials, were obtained when the Colgate-Palmolive Company adopted expanded metal cable trough to support both power and control wiring (in the same trough) at their recently completed Jersey City, N. J., warehouse. The run of trough in this installation measures approximately 300 ft in length, includes both 6- and 12-in. wide sections with 3-in. sides and barrier strips bolted to the bottom of the trough to segregate power from control cabling. A wide variety of fittings were also used to carry cables over, under or around obstructions. And, by connecting several sections together prior to actual installation, fairly long lengths of trough could be raised into position and mounted as a unit.

Cables are open for inspection,

What is a FAIR PRICE?

*To be **FAIR**, both your customer and you must profit.*

Since 1926

NATIONAL PRICE SERVICE

suggests fair resale prices for electrical materials and tells you what they cost from day to day.

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Keep current.

Be FAIR to yourself.

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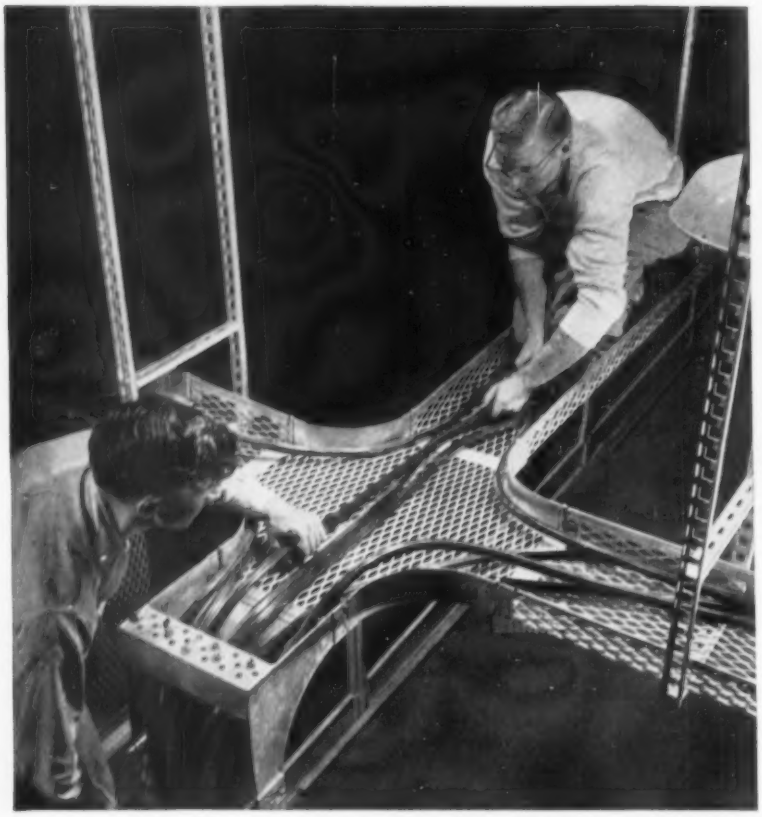


Here's a cable supporting system with space reserved for future needs

COPE CABLE TROUGH GIVES YOUR SYSTEM ROOM FOR GROWTH!

Cope cable trough design gives you greater load carrying capacity per dollar *now—plus built-in system expansibility* that will minimize the cost of future system expansion. A *single* 24" wide section of Cope cable trough supports as many cables as 16 lengths of 4" conduit. Additional cables can be quickly and easily laid in *existing* trough as new equipment installations require. The lower *first* cost of a Cope cable trough installation *saves you money a second time* when you need to increase or expand your power distribution system!

Reduced System Maintenance Costs. Easy-to-get-at Cope cable trough also eliminates costly maintenance problems down the line. Once cable is laid in Cope expanded metal trough, it's readily accessible for easy inspection, repair . . . or *re-routing* when system changes are required. And greater installation flexibility of lightweight Cope cable trough and a complete line of system accessories and fittings reduce design time up to 25% for laying out the most complicated system . . . assure easy system maintenance even in the most cramped quarters.

Cut Costs Three Ways. You save *three ways* when you specify Cope cable supporting systems with pin-type coupler . . . trough, ladder or channel.

- **LOWER FIRST COST**
- **LOWER INSTALLATION COSTS**
- **LOWER SYSTEM MAINTENANCE COSTS**

Discuss these advantages for *your* installation with a qualified Cope representative—or write to T. J. Cope Division, Rome Cable Corporation, Collegeville, Pa.

1002

T. J. COPE *Division*

ROME CABLE CORPORATION

FLEXIBILITY of cable trough system (Cope) is indicated by this picture showing variety of fittings and section details combined in Colgate-Palmolive warehouse, where control wiring, for three conveyor systems is carried alongside power cabling, high- and low-voltage wiring being segregated by means of a barrier strip bolted to the bottoms of the trough sections.

repair and rerouting; ventilation is unobstructed; capacity of the troughs is large, and installation time was kept to a minimum.

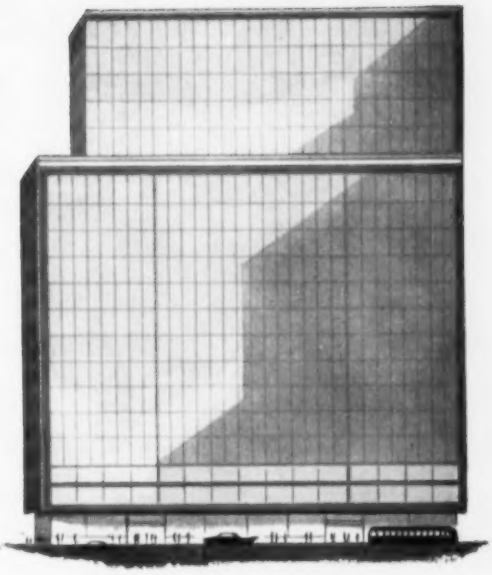
Electric Drill Notches Wood Joists and Studs

TOOLS

Notching wood joists and 2 by 4 studding to seat branch circuit conduits is common practice in frame construction. When raceways are flush with the studding, wall board, plaster board or metal

NOTCHING JOISTS is done with an electric drill and long-shank wood bit. Very litt'e upward pressure on drill is needed as threaded tip pulls bit into the wood.

LOOK FOR A BUILDING



WITH PEOPLE IN IT

AND YOU HAVE A PROSPECT FOR EXIDE EMERGENCY LIGHTING

Stores, factories, theaters, schools, restaurants, offices—they all need Exide Lightguard® emergency lighting units. Most buy several. You make a good profit on every sale. Here's a tremendous market, scarcely tapped. Get in on the ground floor. Become a dealer for Exide Lightguard units—foremost in the field. Send coupon today.

When power fails and lights go out, Exide Lightguard Emergency Lighting Units go on—instantly and automatically. Plug into regular outlets. Automatic built-in charger. Batteries last for years.

Exide® **Industrial Division**
Electric Storage Battery Company, Phila. 2, Pa.
Send details on Exide Lightguards—and how I can become a dealer.

Name_____

Street_____

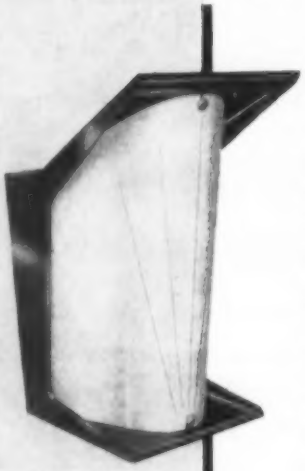
City_____ Zone____ State_____

My business is_____

16

1ST AGAIN

FIXTURES *Complete with Shallow Pan, for* Surface Mounting...



No. 199-2
With Shallow Pan
No. 199-3
With Bracket

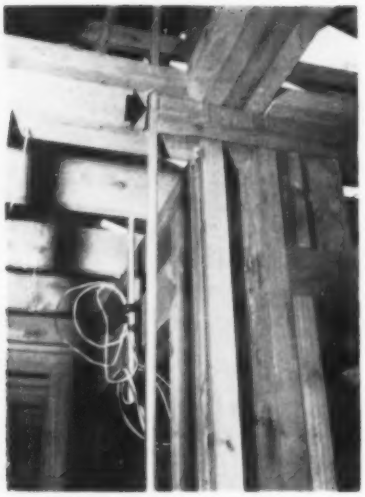
These ultra-modern fixtures are designed to accentuate the style in present day residential building trends. They are the first which can be obtained complete with box for a low-cost surface installation or the conventional bracket mounting.

The 199-2 or 170-2 fixture has a shallow pan for surface mounting on clapboard siding which takes the place of cutting-in an outlet or switch box; the 199-3 or 170-3 fixture comes with a bracket for conventional mounting.

Whichever you choose, you get a complete fixture. And remember! Union Fixtures are Non-Metallic, Non-Corrosive and Non-Staining.

No. 170-2
With Shallow Pan
No. 170-3
With Bracket

UNION INSULATING CO.
Parkersburg, West Virginia



CLEAN CUT notch and hole (arrow) is cut in timber framing in single operation with electric drill. New drilling technique considerably reduced notching time per house.

lath can then be installed without fear of "bulges" where electrical circuits occur.

Normal procedure is to gouge out these niches by using a saw, chisel and hammer. But this was much too slow for A & B Electric Company (Lake Forest, Ill.), project electrical contractor for Elk Grove Village—the 6,000-home residential community being built by Centex Construction Co., Inc., northwest of Chicago. They wanted a quick, easy method that would enable their mechanics to keep well ahead of other trades in this giant project.

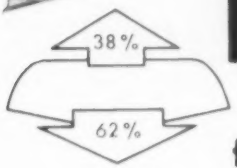
An electric drill with a long-shank wood bit was the answer. Power was readily available, since underground electric service to each house was installed, energized, and equipped with a temporary power outlet before the framework went up. With this arrangement, notching became a comparatively simple chore requiring only a few seconds per notch.

A & B electricians use a Planetor wood bit equipped with a long, threaded, replaceable tip which acts very much like a wood screw. As the bit rotates, the threaded tip guides and "pulls" the bit into the wood permitting a quick, clean, off-center cut. The resultant notch looks like a three-quarter circle cut out along the edge of the studding and forms a natural saddle for the conduit or tubing.

The key to accurate notching is the long, threaded tip of the bit, since the point guides the cutting edges and keeps the bit from slipping off the edge of the studding.

New! DAYSTAR

THE BIG CHANGE IN FLUORESCENT LIGHTING



A NEW DIRECT--INDIRECT LUMINAIRE
for 4 ft. 430 M.A. Rapid Start and 4 & 8 ft. Slimline Lamps

Now Lighting Products Inc., pacesetter to the lighting industry, presents **DAYSTAR** a revolutionary new luminaire designed for better lighting in class rooms, offices, commercial and industrial areas . . . wherever high levels of quality illumination are desired.

The New **DAYSTAR** is available in 48 and 96 inch length with 35° crosswise and 25° or 45° lengthwise shielding. 62% of the light is directed down and 38% up.

The side panels are of steel or plastic. The steel panels are permanently attached. The polystyrene plastic panels are readily removable without the use of tools. Eight foot units utilize both side panels and louvers that give an uninterrupted continuity of design. Louvers have a special snap-in catch and are suspended from the channel by safety chains for ease of relamping and maintenance. All metal parts are finished in high reflectance baked white enamel over a phosphatized surface.

The New **DAYSTAR** is completely described and illustrated in color bulletin No. 1503.

MAIL COUPON TODAY!

LIGHTING PRODUCTS INC., Dept. 4-M, Highland Park, Ill. No. 1503

Name _____

Address _____ City _____ State _____

Certified Lighting

LPI

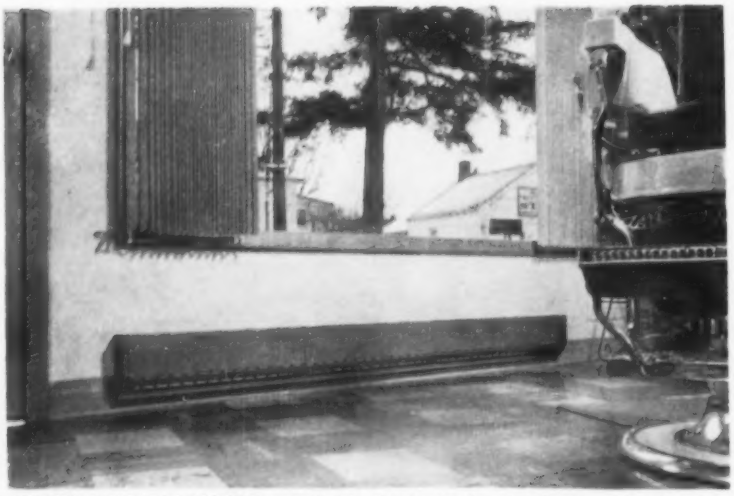
LIGHTING PRODUCTS INC., Highland Park, Illinois

GAIN MORE FREE TIME WITH THE NEW G-E

EASY-TO-WIRE METER SOCKET

It's fast to wire and easy too—installing the new, improved General Electric S-1 square meter socket is a snap. Comes with lay-in terminals and plenty of knockouts—an electrician's delight. And versatile! Your choice of one, two or no hubs. Priced right too! Get details from your G-E Distributor or WRITE FOR FREE BULLETIN GEA-6563, G.E. Co., Schenectady 5, N.Y. Sec.625-8.

GENERAL ELECTRIC



ELECTRIC HEATING UNITS installed in the barber-beauty shop combine heating effectiveness with pleasant and streamlined appearance.

Baseboard Electric Heating Warms Barber-Beauty Shops

HEATING

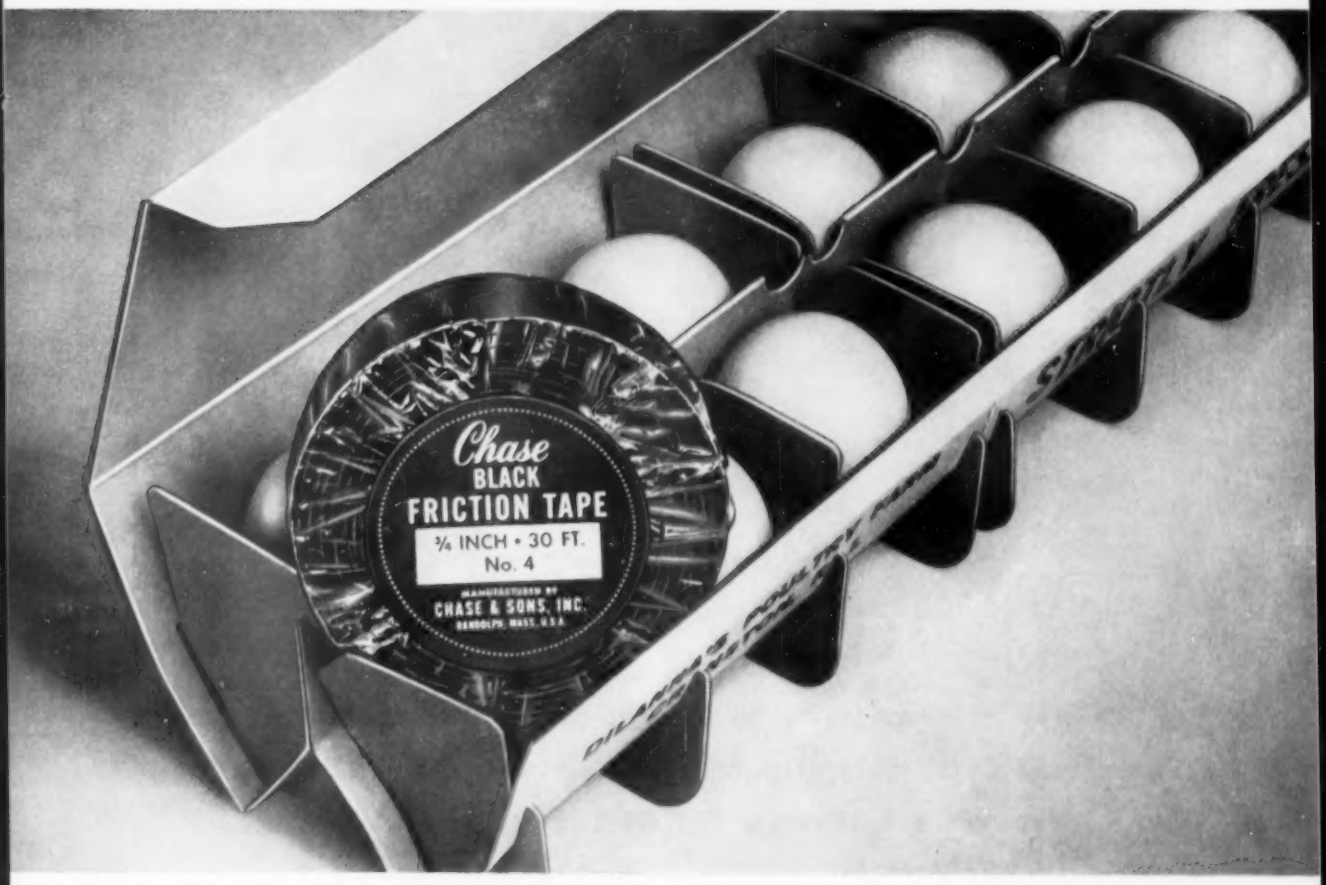
A combined barber and beauty shop in Portland, Ore., is being heated by Westinghouse baseboard electric heating. Comprised of six 500-watt sections in the barber shops and seven such sections in the beauty parlor, the installation provides fast working and easily controlled heating of relatively small working areas. In each shop, the units are controlled by individual thermostats which turn off the units at night; in the morning, the heating units take but a few minutes to warm the shops comfortably.

The heater sections are 2 ft long by 7 in. high, and fit together to form a continuous, streamlined unit which replaces the ordinary baseboard in both shops.

The owners of the shops report that they have had no heating problems despite the frequent opening and closing of outer doors and that they have found the installation very economical.

DELUXE WARM WHITE rapid-start T-12 40-watt fluorescent lamps on 6-in. centers, shielded by translucent 2-by-4 ft or 4-4 ft plastic panels, illuminate this women's apparel shop in Racine, Wis., to average intensity of 50 footcandles, while 150-watt R-40 recessed downlights provide additional light for accent purposes. Circular ceiling coffers with shielded perifery lamps, plus striplights positioned above and inside wall racks, further highlight the merchandise displayed and sold in this predominantly green-grey shop.

Fresher... by far!



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Repulsion-start Induction 1 through 5 hp.

NOW...Wagner's high starting torque Integral hp single-phase motor is available in the latest NEMA frame sizes!

The well-known Wagner Type RA Motor is the workhorse of the single-phase motor field. This repulsion-start, induction-run motor combines the best features of the repulsion motor in starting, with those of the induction motor while running at rated operating speeds—ideal for applications requiring high starting torque.

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Specifically designed for compressors, pumps, machine tools, grinders, and conveyors; it is preferred for many other single-phase high inertia or heavy friction starting applications because of its ability to start such loads with low current and with minimum light flicker.

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OLD FRAME SIZE	NEW FRAME SIZE
203	182
204	184
224	213
225	215
254	254U

4 pole (1750 RPM, 60 cycle and 1450 RPM, 50 cycle) ratings are interchangeable in mounting dimensions with capacitor-start motors of the same ratings.

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In The News

IES Annual Technical Conference In Atlanta Is Attended By 900

For five crowded days last month (9th to 13th), over 900 members and guests of the Illuminating Engineering Society focussed the attention of the lighting industry upon Atlanta, Ga., where the Biltmore Hotel of that city served as headquarters for the Society's 1957 National Technical Conference.

Emphasizing the fact that lighting deeply concerns a wide cross-section of electrical-industry interests was a registration list that included contractors, consulting engineers, architects, utility representatives, government personnel, educators and manufacturers. And, emphasizing the fact that lighting interests recognize no topographical boundaries was the presence of delegates from every State in the Union, plus others from Canada, London, Japan, Bermuda and South America.

In physical size, this conference ranked as third largest in I. E. S. history. And, program-wise, technical and social events alike ranked among the Society's all-time "highs". As usual, the annual Progress Report and MMILJ Competition attracted the interest of SRO crowds; the Gold Medal Award and Officers' Reports were of definite interest, and the 34 technical papers presented during the conference were fact-packed and informative.

Progress Report Spotlights New Lighting Products

At the always-popular Progress Report, over 75 separate items (designed by foreign as well as by American lighting engineers) were displayed and spotlighted in a dramatic animated presentation aptly subtitled (with apologies to Hollywood) "Around the World in 80 Minutes". Furthering the illusion of the movie take-off, background music consisted of the theme from "80 Days", while J. Hugh McCulloch from Independent Testing Laboratories in Boulder, Colorado, chairman of the Progress Committee (appropriately attired for the occasion in the beaver top-hat and swallow-tail coat of Phineas Fogg) drove down the center aisle to the stage astride a motorcycle. In the 80-minute report that followed his entrance, he used full-color slides, film-clips, dozens of inanimate products, plus a live, shapely model (electrically attired in a twinkle-light bathing suit) to tell his interesting story.

His story was an all-inclusive one, covering a wide range of industrial, commercial and residential lighting products, and featuring such items as airport beacons, waterproof units for underwater applications, football-sized mercury-vapor lamps with tiny tungsten filaments replacing bulky ballasts of earlier models, jet-plane wing-tip lamps designed to withstand strains of supersonic flying, explosion-proof mine lamps, "rug-sized" luminous ceiling fixtures for homes, fiberglass forms for concrete slab application, newly-designed street- and floodlighting units, portable mercury floods and "concretable" fixtures designed for direct installation on "mud jobs".

Assisting Chairman McCulloch in this presentation were E. A. Linsday, General Electric Co., vice-chairman, plus 19 additional committeemen who toiled unseen to help make the report the success that it was.

St. Louis Airport Receives Recognition

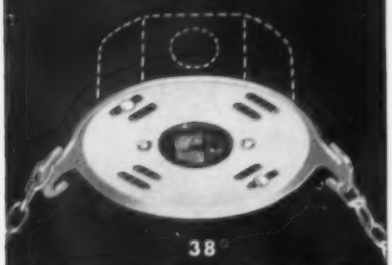
Another ever-popular highlight of the convention was the annual "My Most Interesting Lighting Job" competition. 18 regional winners competed for cups, certificates and checks in two categories; residential (where aesthetics is the prime objective), and "everything else" (where functionalism and efficiency are the determining factors).

As judged by C. I. Crouch, James M. Ketch and Ted Sargent, the "everything else" category was finally headed by H. J. Poehling from the St. Louis Section, who discussed the lighting features of the St. Louis Municipal Airport terminal building. Second prize in this same group went to Lawrence T. Genise, Michigan Section, who described the lighting in the exhibition swimming pool of the University of Michigan. Earl I. Dinsmore from the North Texas Section discussed restaurant lighting to win the third prize, while fourth place was awarded to Werner F. Rosacker of the Eastern Pennsylvania Section, whose entry was titled A Challenge in Church Lighting. Other finalists in this division included G. Denis, who represented the Canadian Region; Robert J. Uhl, Inter Mountain Region; J. F. Barney and Russell Benjamin, Northeastern Region; B. T. Heinz, Pacific Northwest; Harold Strahn, South Pacific Coast; Herbert Gregory, South Central, and Everett D. Stevens, Southeastern Region. Lighting installations discussed by these entrants included stores, telephone buildings, a library, sales office, meat packing plant and another church job.

KIRK M. REID, senior illuminating engineer of G.E. Lamp Division at Nela Park, Cleveland, was elected at Atlanta convention to I.E.S. presidency for 1957-58 season.

In the Residential division, the four winners were Edna P. Fortier of New Orleans; George E. Matilo, Cleveland, Ohio; Jack T. Cottingham, Portland, Oregon, and Edwin Schnoll, Milwaukee, Wis. Other finalists in this division included D. R. Webb, Maritime Chapter; Simon Erlich and David Weisblatt, Maryland Section; Gerald Joseph, New Mexico; Sylvan Shmitz, Connecticut; and Al Schramm, San

IDEAL SIMPLET



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PROF. JOHN O. KRAEHENBUEHL (right) of the University of Illinois and Colorado College received the I.E.S. Gold Medal, the Society's highest award, in recognition of his far-reaching influence on the techniques of illumination. Marshall N. Waterman (left) retiring president, made presentation at annual convention in Georgia, while past- and incoming-chairmen of the local section, John E. Sweatte and William M. Pearson, witness the ceremony.

Diego Section. Judges in this division were L. Ralph Busch, E. W. Commery and Myrtle Fahsbender.

Gold Medal Awarded

One of the highlights of the opening session was the presentation of the I. E. S. Gold Medal Award, the Society's highest honor, to Professor John O. Kraehenbuehl. He recently retired as professor emeritus in electrical engineering at the University of Illinois after 35 years as a faculty member of that institution, and is presently developing a pre-engineering curriculum at Colorado College. He is also a prominent consultant in a variety of engineering fields, and has been a Fellow of the Society since 1947.

The medal was presented to Professor Kraehenbuehl in recognition of "his far-reaching effect on the techniques of illumination in his long academic career, and his personal sacrifices in promoting the nation's general welfare through teaching the importance of scientific lighting". Since it is estimated that approximately 25% of all leading lighting engineers of today received their initial lighting instruction as students of Professor Kraehenbuehl, the appellation of "the nation's most distinguished teacher of the science of lighting" was a fitting tribute to the recipient.

Members of the medal-award committee which selected Professor Kraehenbuehl included Berlon C. Cooper, *Electrical Construction and Maintenance Magazine*, Chairman; Prof. Everett M. Strong, Cornell University; Robert F. Hartenstein, Ohio Edison Company, Akron, Ohio; Duncan M. Jones, Curtis Lighting of Canada, Ltd., Montreal; Charles H. Goddard, McGraw Edison, West Orange, N. J.; Lee E. Tayler, Detroit (Mich.) Edison Company; Julius Daniels, Boston (Mass.) Edison Company; Hoyt P. Steele, Benjamin Electric Manufacturing Company, Des Plaines, Ill., and Bruce J. Jensen, Public Service Electric and Gas Company, Newark, N. J.

Kirk Reed Elected President

Elected to lead the Society for the coming year in the capacity of president was Kirk M. Reid, senior illuminating engineer of the General Electric Company's lamp division in Cleveland, author of numerous technical papers, widely recognized authority on street and highway lighting, an electrical engineering graduate of Cornell University, and long-time (37 years) leader in the lighting profession. In his new office, he succeeds Marshall N. Waterman of the Westinghouse Lamp Division, whose term

introducing the TSA-47

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All-new Time Switch

Designed, built, and tested to handle your regular-duty, indoor time-controlled jobs. Provides greater reliability and long-life operation at low cost. Available with double-pole or single-pole contacts.

General Electric's versatile new TSA-47 is a top-quality time switch at *ordinary time switch price.* Packed with years-ahead features, the TSA-47 will provide the *reliable* control you need, too . . . day after day, year after year . . . for a wide variety of timing jobs.

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- **EXCLUSIVELY DESIGNED OMITTING DEVICE** can be put in or taken out quickly and easily *right in the field.*
- **12 ON-OFF OPERATIONS** in a single day are possible. You can set your time cycles as close as one hour apart.
- **FOR OUTDOOR APPLICATIONS,** internal mechanism is available for the first time in a truly rain-tight case at new low cost (Type TSA-41).

General Electric also offers the rugged TSA-40 for your heavy-duty timing jobs either indoor or outdoor.

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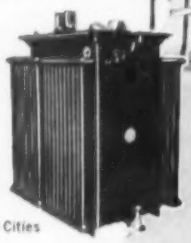

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CODE CALL
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was officially terminated during this national convention.

Assisting Mr. Reid in conducting the Society's activities will be George J. Taylor, eastern manager of Day-Brite Lighting, who will serve as the Society's senior vice president, and Richard G. Slauer, product sales manager of the Sylvania fixture division at Wheeling, W. Va., who was re-elected general secretary.

Others who were named to national and regional offices of this 9,000-member professional organization included Joe B. Browder, Georgia Power Company, new junior vice president; James R. Chambers, Appleton Electric Company, Chicago, treasurer; J. Dixon Mitchell, Westinghouse Lamp Division, Chamblee, Georgia, director, and J. D. Whitnell, Arizona Public Service Company, Phoenix, also a director.

New regional vice-presidents elected for two-year terms were James A. Banton, Tampa (Florida) Electric Company; A. E. Fleming, General Electric Supply Company, Salt Lake City; Reuben K. Lothrop, Southwestern Gas and Electric Company, Shreveport; Charles C. Shotwell, Philadelphia (Pennsylvania) Electric Company, and J. Carl Wilson, J. A. Wilson Lighting and Display, Ltd., Toronto.

Officers' Reports

Speaking at the opening session of the convention, retiring president Marshall N. Waterman noted that, due to the slackening of demand for engineers in the general fields of electronics, additional engineering talent was becoming available in the field of lighting, resulting in a growing potential for illumination and causing would-be engineers to measure their abilities in terms of lighting needs. Citing the past growth of the lighting industry, he pointed out that growth should be even faster with a full complement of engineers available, and that public demand for lighting would continue to increase as new lighting products continued to add to the pleasures of modern living.

Emphasizing the contributions that have been made by technical lighting studies carried on by the Society during the past year, incoming president Kirk M. Reid cited some recent findings on the effect of glare, on the quality of light and on the structure of fog, this study being designed to increase visibility for night highway drivers under adverse weather con-

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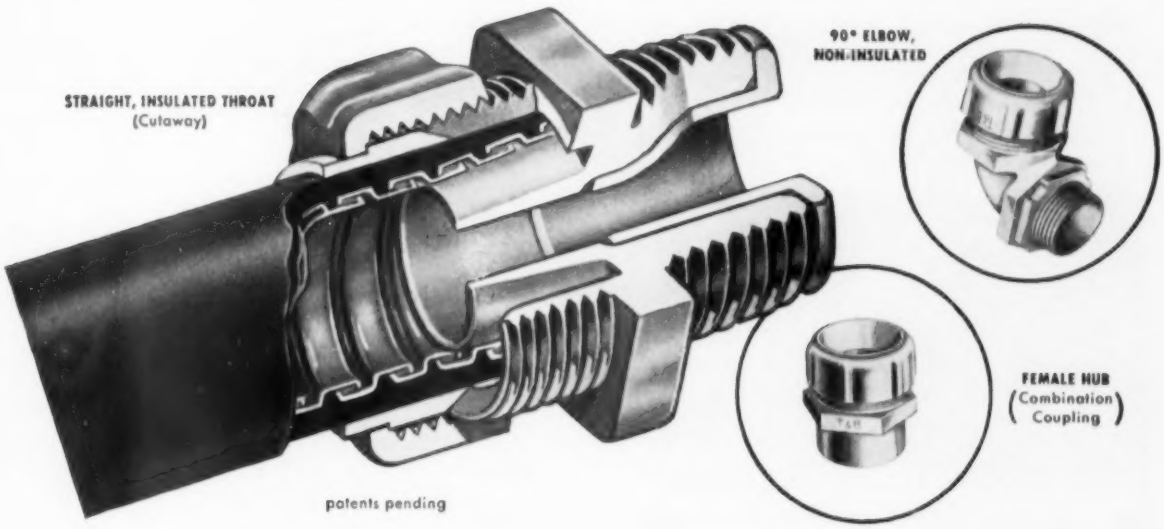

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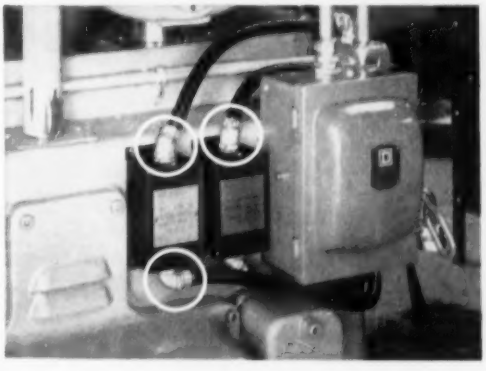

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ditions. Another illustration of lighting progress mentioned the recent analysis, measurement and duplication of a typical north sky, making it possible for graphic arts people to now match colors accurately and to mix pigments accordingly.

In the secretary's annual report, Richard G. Slauer stated that the IES is growing at the rate of 4% per year; that the Society's membership now numbers over 9,000; and that the organization now includes 77 sections and chapters throughout the United States and Canada. He also summarized the year's work of some of the Society's standing committees, particularly citing the progress of the Allied Arts committee in transmitting knowledge of lighting into fields where lighting is now recognized as a structural and aesthetic tool as well as being a practical necessity.

Georgia Tech Wins Allied Arts Contest

During the course of the IES convention it was also announced that Georgia Institute of Technology, Atlanta, had won the Society's nationwide annual Allied Arts contest, and that second and third places had been awarded to the University of Southern California and Pratt Institute of Brooklyn, N. Y.

This contest, centered primarily on architectural colleges, and with three-way collaboration between art, industrial design and engineering groups, has as its objective the dissemination of knowledge of the art and science of illumination as part of the curriculum of building-design courses. These contests therefore bring architects, engineers and designers together as students, so that they may learn something of each other's problems, language, misconceptions and preconceived ideas which ordinarily would become evident later in their professional lives.

Lighting Applications Cover Broad Scope

While it is not the intent of this news report to review in detail all of the 34 technical papers presented during this 4-day conclave, it is pertinent to state that the scope of these many papers covered a wide range of interests in the fields of lighting applications, photometry and colorimetry, light sources, research, calculations, street lighting, daylighting, light-

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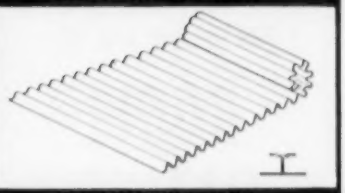

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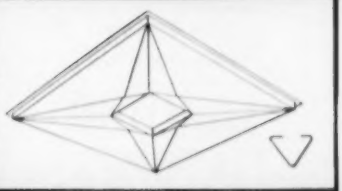
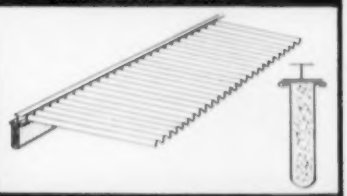
Molded Vinyl Panels
Steel "V" Track



ACUSTI-LUMINUS CEILING
Corrugated Vinyl Plastic
Steel or Aluminum Tracks
with Acoustical Baffles



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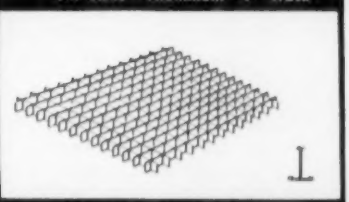

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Flat or Formed Plexiglas
Steel or Aluminum "T" Tracks

MAGNA-LUMINUS CEILING
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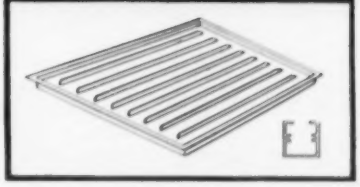
Square Track



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ing for TV production and residential installations.

Of particular interest to contractors and consultants attending the sessions were those papers pertaining to such application subjects as acoustics; the extraction of heat from fluorescent luminaires in air cooled rooms; experiences with high level office lighting; lighting environments incorporating mediums for changing intensities, patterns and colors; application of non-circular cross-section fluorescent lamps; uses of new mercury lamps; optical applications of mercury short-arc lamps; and fluorescent strip runway lighting for airports.

In the order listed above, these papers were prepared and presented by such recognized lamp-manufacturer spokesmen as George W. Clark, Sylvania; Walter Sturrock and Lester F. Schutrum, general Electric and American Society of Heating and Air Conditioning Engineers Laboratory, respectively; J. M. Ketch and W. S. Fisher, G. E.; George Clark and Richard Harz, Sylvania; G. R. Baumgartner, R. T. Dorsey and E. A. Linsday, G. E.; D. R. Phillips and E. C. Martt; G. E.; E. W. Beggs, Westinghouse, and S. C. Peek, Sylvania.

In this group of papers, Mr. Clark stated that the growing importance of extended area lighting systems and the trend toward higher illumination levels at lower ceiling heights using recessed or surface mounted luminaires has made it necessary for the illuminating engineer to have a thorough understanding of acoustics in order to better promote good lighting, and that the illuminating engineer cannot ignore acoustics without losing much of the initiative in designing of lighting systems to the architect, consulting engineer or acoustical engineer. In developing his thesis, he explored coefficients of noise reduction, standards for acoustical treatment, reverberation time, noise isolation and insulation.

The second paper in this group showed by progressive calculations that many fluorescent lighting systems employ luminaires of the open bottom or louvered direct type and that tests indicate that about 42% of the watts consumed by such units will be converted into radiant energy with about 58% in convected heat. When these direct types of luminaires are built into a ventilated ceiling with glass or plastic bottom plates, or are installed above a ventilated false

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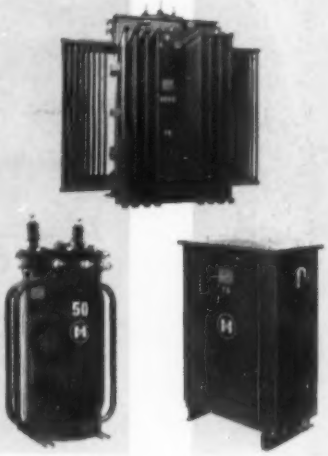

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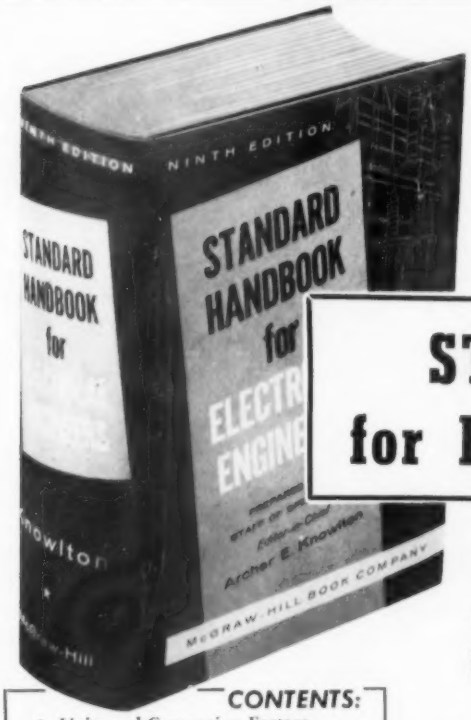

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ceiling, it seems evident that the low temperature radiation and convected heat transferred into the room will be considerably less than obtained from luminaires suspended below the ceiling. Because of this, the authors concluded, it seems logical that fluorescent lighting systems of so-called luminous-ceiling design will have their energy most effectively dissipated if a cooling system, either of circulating air or coils of cold water or a combination thereof, can be installed above the ceiling in a manner to remove heat before it enters the room.

The third paper, by Ketch and Fisher, premised that since there is a wide gap between the levels of illumination which laboratory tests indicate as desireable for office tasks and those which are currently being installed, much useful data in this connection could be obtained from living and working for lengthy periods under high levels of illumination. The authors therefore had installed and had worked for more than a year under two high-level installations; one providing lighting in the order of 200 footcandles, the other providing more than double that amount. Their conclusion showed that good direct-view comfort could be maintained under these high levels by either using increased shielding (52½ degrees) with louvers made of low-brightness materials, or by using special controlling reflector and louver shapes. Their tests also indicated that, in general, present IES reflectance recommendations were satisfactory for work beneath several hundred footcandles of illumination. It was interesting to note that, of the many visitors who had inspected and worked beneath the controllable higher-level (up to 400 fc) installation, no one desired less than 100 fc of illumination; the majority preferred the 200-300 fc range, while a few felt that levels above 400-fc would be beneficial.

Footcandles and Footlamberts; What Next?

Under this intriguing title, Messrs. Clark and Harz recalled that IES office lighting standards had been 4-8 fc in 1917; 8-10 fc in 1930; 25 fc in 1942 and 30 fc in 1956, although a minimum standard of 50 fc for difficult office tasks is now being recommended. They also showed how mere quantity of light had gradually taken quality into account, and that the new concept had brought forth the basic

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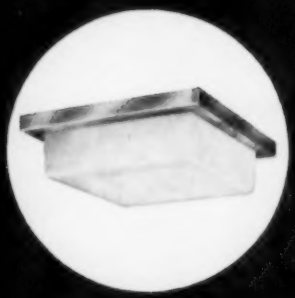

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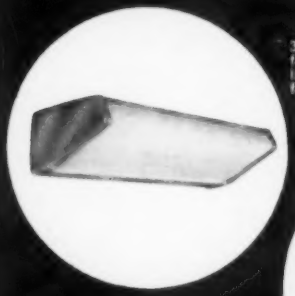

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thinking of brightness engineering. Believing that any lighting problem is affected by eight factors (illumination, brightness distribution, specular reflection, shadows, spectral distribution, psychological effect, aesthetic effect and economics), the authors had deduced that three areas of change are also available (spectral quality, appearance of the lighting system and intensity of illumination), and that these changes can be obtained by integrating color, using rheostats and variable impedance transformers, considering dimmer ballasts and control equipment, rearranging luminaire design and shape, altering the brightness pattern in the visual field, and changing the color, form and texture patterns of luminous or translighted ceilings, making these changes at periods of years, seasons, days, hours or even minutes.

To pursue their conclusions, the authors then discussed the creation and use of an experimental conference room incorporating continuous plastic panels, modular plastic panels, various dimming equipment and design elements, showing finally that it is economically practical to include aesthetic and psychological or psychophysical considerations in today's lighting practices for offices, drafting rooms, classrooms and semi-industrial areas.

In the discussion pertaining to the application of non-circular cross-section fluorescent lamps, it was brought out that increased light output per foot of fluorescent lamps, at efficiencies comparable to previous sources, has been an important step for improved lighting, and that these characteristics, together with acceptable life and lumen maintenance, had been provided over a year ago by lamps having non-circular cross sections. Then, discussing bulb construction, candle-power distribution, effect of ambient temperature, fixture design, temperature considerations and various applications, the authors concluded that the higher output and lower cost of light provided by this radically new design offers opportunities for simpler installation, greater flexibility as to patterns of lighting equipment and markedly higher lighting levels.

The paper discussing the uses of new mercury lamps for general lighting purposes covered two separate categories of light sources: jacketless, quartz, high-output sources, and color-improved reflector sources. Under the first cate-

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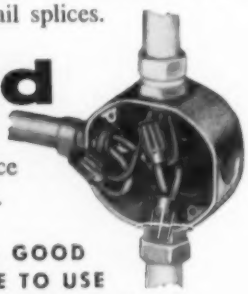

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gory, the authors discussed operating requirements, lamp design and data, luminaire design and blacklight applications. Under the second category they discussed design features of 400-watt reflector lamps, 1000-watt reflector lamps, reflector lamps combined with external reflectors, and installation of these light sources. In this paper it was also mentioned that the new 1500-watt tubular all-quartz mercury lamp provides a compact high output source which is well suited to many floodlighting applications, since its high efficiency and relatively small size makes it advantageous for use at higher mounting heights.

The final two papers in the Applications sections covered optical applications of mercury short-arc lamps, and fluorescent strip runway lighting. In the first of these two papers, Gene Beggs of Westinghouse illustrated the fact that two types of short-arc mercury lamps are now in general use: the mercury lamp with a small amount of argon as the ionizing or starting gas, and the mercury-xenon lamp designed with a pressure of several atomospheres of xenon gas to provide intense illumination within a few seconds after the arc has struck. Mr. Beggs' talk then included a discussion of searchlight optics, landmark beacons, optical design of instruments, image projectors, photocopy and photochemical applications, concluding with the statement that these lamps are invading the field of optics today chiefly because they are high brightness "point sources" of light that operate with the simplicity and consistency of incandescent lamps.

Discussing fluorescent strip runway lighting, Mr. Peek stated that lights positioned along either side of a runway serve only as beacons, and that the resulting "black hole" of the runway itself is becoming increasingly dangerous as the "jet age" approaches with faster landing speeds and less stability of aircraft just prior to "touchdowns". However, the recent development of very high output fluorescent lamps now provides a means of adequately floodlighting a runway from the low elevations required by propeller clearance; emitted light from low luminaires illuminating the runway at grazing levels to reveal and exaggerate protrusions and minor changes in the runway contour.

In these new floodlighting units, the contour of the reflector and position of the lamp is such that

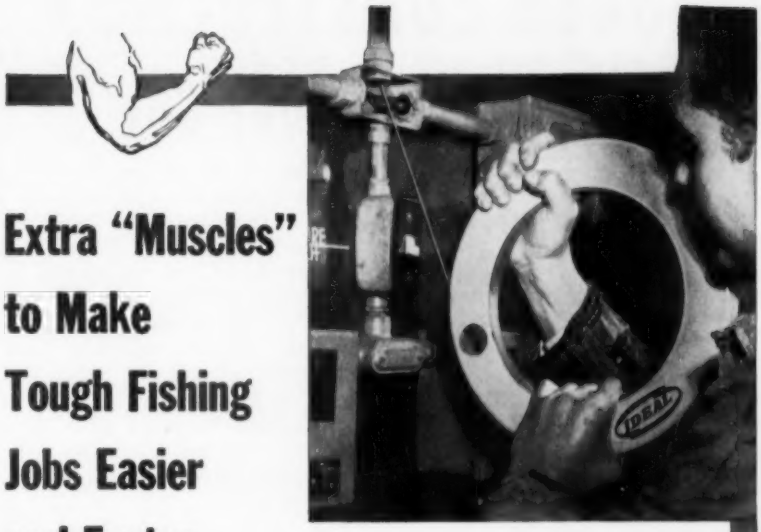
light rays are reflected horizontally across the runway so that upward glare components will not disturb the pilot of the landing plane. Mr. Peek's paper concluded that the development of very high-output fluorescent lamps of relatively small diameters, plus the use of carefully-designed luminaires, makes it practical to now illuminate long, narrow areas such as runways by this means.

New Lamps Have Bright Future

In another series of discussions, four new types of lamps were analyzed as to development procedures, construction details and potential applications. These lamps included Sylvania's VHO lamp (discussed by C. J. Bernier and W. C. Gungle), General Electric's non-circular "power grooved" lamp (discussed by J. O. Aicher and E. Lemmers), new deluxe fluorescent-mercury lamps (discussed by W. S. Till of Westinghouse), and smaller, more efficient 100-watt incandescent lamps now available (discussed by P. B. Jordan, C. W. Pearson and W. H. Fisher of G. E.).

As pointed out in the first of these four papers, the fluorescent lamp has enjoyed phenomenal acceptance for lighting large areas, due almost entirely to its high efficiency and low surface brightness. For many applications, however, this low brightness is a disadvantage (such as for parking areas, tunnels, high bays, etc.) and there has been a demand from lighting engineers for a fluorescent lamp with a much higher output, causing research engineers to investigate the feasibility of using more efficient phosphors for converting ultraviolet to visible light, and increasing the ultraviolet output of the low pressure mercury arc within the lamp. In the case of the VHO lamp, the use of a conventional T-12 bulb containing a high percentage of neon has resulted in higher efficiencies in loading the lamp, higher electron temperatures and inhibited damaging effects of higher cathode fall. This lamp was then analysed from the viewpoint of design, starting and operating characteristics.

Due to the common high-output characteristics between the VHO and "power groove" lamps, discussions and comments from the floor were numerous, perceptive and fact-prompting, and delegates sitting in on this interesting session received a practical analysis of



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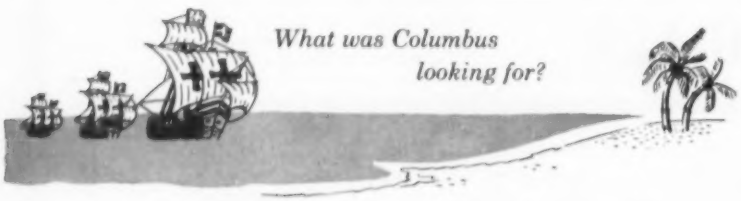

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lamp performance, physical principles involved, design evolution, effect of starting gases on discharge characteristics, efficiency as a function of cathode heating power, and mercury vapor pressure control.

In the discussion of deluxe fluorescent-mercury lamps, it was shown that new experimental lamps have been created in shapes and sizes corresponding to those of standard lamps of equivalent wattage, and that better color rendition is obtained by the use of outer bulbs having a colloidal metallic coating of a light purplish color. Light output is about 80% of that of regular fluorescent-mercury lamps, but the deluxe lamps are practical and economical for many applications; several satisfactory jobs already having been installed around the country.

As to the new 100-watt incandescent lamps, it was stated that axial filament mounting had resulted in a smaller package producing 6% more mean lumens, and that the development of this lamp represents the most important incandescent lamp development in the general service types since the introduction of the coiled-coil filament in 1936. Problems of design, patterns of light distribution and life-efficiency relationships were then discussed.

Indicative of the wide range of lighting subjects included in this year's IES annual technical conference were sessions on residential and street lighting, both of which attracted large audiences and prompted considerable debate.

Included on the residential agenda were papers by Miss Mary Taepke, lighting specialist for the Detroit Edison Company; E. W. Commery from the lamp division of G. E. at Nela Park, and Dr. Domina E. Spencer, associate professor at the University of Connecticut. In that order, they discussed how to obtain modern lighting in a concrete and glass-walled cooperative apartment—after construction had been completed. how to coordinate light and structure in modern homes, and how to create luminous ceilings with the use of incandescent lamps. Numerous excellent color photographs, floor and wiring plans, wiring and control diagrams made this session an informative and stimulating meeting.

As to the session on street lighting, Abe H. Feder, lighting designer and consultant of New York City, went into detail concerning the outdoor lighting design for

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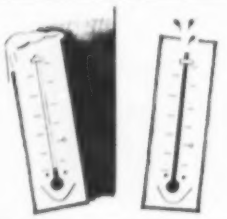
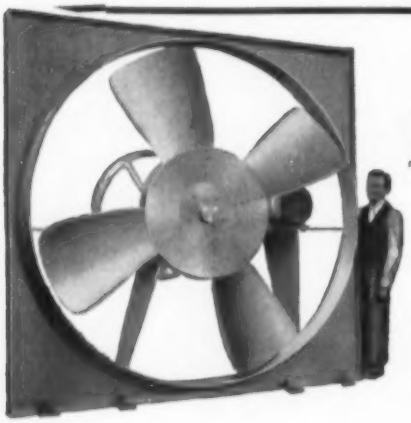


OPERATING RANGE —50F TO +200F

This exceptionally wide 250 degree operating temperature range is made possible by the use of a special silicone lubricant in the Sangamo-built slow speed motor. This lubricant assures continuous operation in extreme cold or heat. See these rugged, all-weather time switches at your Electrical Wholesaler's today.

Sangamo Electric Company

ST57-5 SPRINGFIELD, ILLINOIS



EASY-TO-SELL, EASY-TO-INSTALL!

"BUFFALO" PACKAGE PROPELLER FANS

- Propeller Fan Economy—once considered not practical on many jobs.
- Shipped As Complete Packages —ready for installation in wall or window opening.
- Biggest Size Range—24" to 120"—for 5,000 to 250,000 cfm capacities.
- Wide Choice of Designs—to suit many commercial and industrial applications.
- Performance Meets Test Codes of A.S.H.E., N.A.F.M., P.F.M.A. and U.S. CS-178.

Now, You Can Do Many of Those "Big Jobs"—as well as the smaller ones—with the *complete* line of "Buffalo" Belt-Air Fans.

Write for Bulletin F-M 315 Today!

BUFFALO FORGE COMPANY

520 Broadway Buffalo, N. Y.

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

"Buffalo"

INDUSTRIAL EXHAUSTERS BELTED VENT SETS PROPELLER FANS "E" BLOWERS-EXHAUSTERS

New York's International Airport (a subject which will be discussed further in an early issue of EC&M); Robert G. McPhail of the Holophane Company analyzed light distribution from linear source street luminaires; John W. Young of the New England Power Service Company in Boston discussed application experience with mercury vapor lamps in street lighting service, while T. Summers, Jr., of Westinghouse, presented methods for estimating the cost of a roadway lighting system.

Details Planned by Over 200 Committeemen

Since sessions and papers briefly noted in this report represent less than half of all those included on the complete program, it is rather amazing that the busy 5-day conclave also managed to include a plantation party, barbecue, golf tournament, bingo parties, a sightseeing tour, two receptions, two dances and a banquet.

Committee members responsible for the many social and technical events numbered considerably over 200, so the success of the convention was no accident. While space limitations prevent listing all of their names, editorial recognition should be directed to such conference committeemen as Joe Browder and J. D. Mitchell, chairman and vice-chairman of the local Atlanta executive committee; Judd Lough, Ch., Finance; Jack Murrah, Publicity; Jack Burns, Entertainment; T. Taylor Peake, Transportation; J. E. Sweatte, Hotel; S. J. Andre, Reservations; Thomas W. Haslam, Audio-visual; Charles R. Minors, Conference rooms; Harry T. Yopp, lighting and decorations; Cecil L. Cannon, Reception; Alfred E. Bruner, Sports, and Ladies Reception; co-chairwomen Miss Emily Alexander, Mrs. L. Ralph Bush, Mrs. R. J. Kuzell and Mrs. Bruce Moran. Mention should also include J. C. Forbes and C. L. Amick, chairman and v-ch. of the National Technical Conference Committee; H. F. Davidson and B. S. Benson, dittos of the Papers Committee; J. H. McCulloch and E. A. Linsday, ch. and v-ch. of the Progress Committee, and L. E. Tayler and C. W. McCormick of the Lighting Service Committee.

LIVE BETTER ELECTRICALLY

St. Louis Contractor Wins First Prize in BH&G Wiring Contest

Mel Beach of Beach Electric Co., St. Louis, Mo., electrical contractor, has been awarded first prize in the *Better Homes & Gardens* magazine home wiring contest for electrical contractors and their employees.

Beach received a cash award of $500 for his entry describing his best Housepower sale of the year, in which the wiring job provided adequate electrical service for present needs and future expansion in the home.

Purpose of the contest was to learn the successful sales techniques employed by entrants, and to pass them on to the industry; to stimulate electrical contractors to sell more home wiring; to help prepare for future expansion of electrical living; and to give consumers more convenient and safer living in better homes.

Second prize, $250 in cash, went to Mrs. Joseph Laski of Robbinsdale Electric in Minneapolis.

Robert P. Goodrich of Butcher Electric Service in Dallas, Texas, won the $125 third prize.

In addition to the three top prizes, ten $50 awards, 25 $25 awards, and 50 honorable mention certificates were awarded to top entrants from all parts of the country.

Entries were judged on usability of selling techniques by others, originality, and simplicity, by a panel of four electrical industry leaders and the editor of *Better Homes & Gardens* magazine.

Each of the three top prize winners met the homeowners in their homes and used a prepared sales talk as a "tool". Beach marked recommended receptacle, light and appliance locations on a floor plan sketch of the home, and Mrs. Laski illustrated her talk with a fixture catalog and lighting brochures.

In each case, the electrical contractor sold more installations than the customer originally had in mind. Third-place winner Goodrich explained that discussing electrical terms in language the customer could understand was effective in helping the customer choose the right installation.

All three winners emphasized the importance of high quality work, guarantee, and follow-up inspection, rather than using high pressure sales techniques.

The contest entries indicated that homeowners are most interested in improved efficiency, safety, con-

Speed operation of hydraulic conduit benders, cut installation costs with the new, portable GREENLEE No. 798-SA Hydraulic Power Pump

Here's the improved new, *portable* GREENLEE Hydraulic Power Pump that operates a GREENLEE Hydraulic Conduit Bender *three to five times faster* than a hand pump. Team it up with your conduit benders (either GREENLEE or other makes) and see how much faster and easier your jobs go! Big reason is that this pump has the *exclusive* GREENLEE feature of *two-speed action* for fast approach to the work and automatic change-over to lower speed, *high-pressure* drive . . . eliminates costly waiting time for ram to reach the work. This compact, electric motor-driven pump is capable of developing continuous pressure of 6,000 psi and up to 10,000 psi intermittent. It's a powerful, versatile unit for use on hydraulic conduit benders, knockout punch drivers, and many other hydraulic tools you use in the shop or out on the job. Get complete facts today.

Send Coupon Today

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Please send data on the timesaving new GREENLEE No. 798-SA Portable Hydraulic Power Pump.

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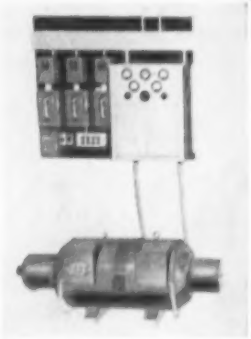
New! 400 CYCLE LIGHTING

GIVES UP TO 20% MORE FOOT CANDLES THAN ORDINARY 60 CYCLE FLUORESCENT OR INCANDESCENT!



"IT'S JUST LIKE WORKING IN SUNLIGHT"

. . . comments a worker in this factory building lighted with fluorescent luminaries using 400 cycle 300/600 volt alternating current provided by a KATO Motor Generator Set.

The results are glare reduced, shadows eliminated and full, even light over large areas. Of course, worker fatigue is cut down and production goes up. Reduced electrical consumption to obtain the same light output as ordinary 60 cycle current would be enough to write off the cost of the KATO MOTOR Generator Set used in this installation in a year's time.

KATO 400 cycle Motor Generator Sets in sizes from 100 watts to 200 KW as well as necessary starting and control panels are available.

ALSO VARIABLE FREQUENCY KATO MOTOR GENERATOR SETS.

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KATO ENGINEERING CO.

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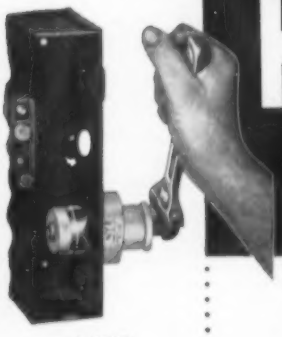
MANKATO, MINNESOTA

Original **NYE 4 POINT KNOCKOUT PUNCH**



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HAND or HYDRAULIC OPERATED

Each Punch ½" to 4" has the ORIGINAL 4-POINT cutting feature which takes the toil out of the job. Cuts clean, quick knockouts speedily, smoothly and burrless. Ball bearing chuck prevents friction. Hand or hydraulic. Try a NYE and know the best. Order today from your local supply house.

Built of highest grade steel.

NYE

NYE TOOL COMPANY

4126 WEST FULLERTON AVE. CHICAGO 39, ILLINOIS

venience outlets, and reserve capacity for future equipment and expansion. Winners said they found out what features interested their customers; then, starting from that feature, they explained the customers' other needs to them.

The $50 prize winners were: C. A. Yarbrough, Yarbrough Electric Co., Franklin Park, Ill.; Arnold S. Rolland, Rolland & Sons Electric Co., Minneapolis, Minn.; George Savidge, Karrasch Electric Co., St. Joseph, Mo.; C. Tamer, Dennis Electric, Detroit, Mich.; P. P. Ries, Ries Electric Co., St. Paul, Minn.; M. S. Hollis, Hollis Electric Service, Carbondale, Pa.; D. Farley, Farley Electric, Milford, Mich.; W. Murphy, Crest Electric Co., St. Louis, Mo.; D. P. Troisi, Electrician, Williamsport, Pa.; K. Mehoffie, Arcanum, Ohio.

The $25 prize winners were: K. Gordon, Modern Electric, Fresno, Calif.; C. J. Sisk, Ajax Electric Service, Washington, D. C.; G. White, A. W. Electric Co., East St. Louis, Ill.; G. B. Buckingham, Watson Electric Co., Detroit, Mich.; F. J. Terpstra, Fred J. Terpstra Co., Detroit, Mich.; L. K. Broman, Briggs Electric Co., Grand Rapids, Mich.; E. H. Winidiate, E. H. Winidiate Elec. Inc., Inkster, Mich.; R. B. Dewey, Dewey Electric, Minneapolis, Minn.; W. Leavey, Central Electric Co., Minneapolis, Minn.; R. Mester, Suburban Electric Co., Minneapolis, Minn.; L. H. Anderson, Leonard Anderson Elec. Co., So. St. Paul, Minn.; G. Clauson, Kostka Electric Co., So. St. Paul, Minn.; J. Grundahl, Norwood Electric, Norwood, Minn.; R. Nauman, Korn's Electric Co., St. Joseph, Mo.; A. Goepfert, Berkshire Electric Service Co., Buffalo, N. Y.; E. R. Durant, Durant's Electric, Gouverneur, N. Y.; R. Keough, Robert Keough & Co., Drexel Hill, Pa.; R. H. Stewart, Jr., Stewart Electric Co., Greensburg, Pa.; W. L. Dunn, Philadelphia, Pa.; J. A. Donahue, Robert Keough & Co., Philadelphia, Pa.; N. Marcus, Marcus Electrical Service, Philadelphia, Pa.; R. L. Hargrove, Electrical Contracting & Maint. Co., Dallas, Texas; R. C. Michaels and W. Riester, Hale Electric Co., Pittsburgh, Pa.; H. LaRue Thompson, Prior & Sallada Co., Inc., Williamsport, Pa.; H. J. Christensen, Hoxsie Electric Co., Warwick, R. I.

LIVE BETTER ELECTRICALLY

Housepower's Plans Announced

Plans for the electric industry's Housepower program for 1958 were announced by E. O. George, chairman of the Wiring Promotion Committee of Edison Electric Institute and vice president of The Detroit Edison Company. He outlined two major promotions for the 1958 Housepower program at a press conference, and reviewed progress of the program to date, which has as its long-term goal the modernization of wiring in an estimated 20,000,000 American homes.

A $100,000 contest will be launched for the spring, as the first of the 1958 promotions, Mr. George said. Starting during National Electrical Week (Feb. 9-15) the contest will have as its theme "Write a Caption for this Cartoon." The cartoon will show a low Housepower situation. Advertisements in major consumer publications will announce and publicize the contest and the Housepower program for 1958.

A 20-page, two-color consumer booklet, "How to Plan for Better Living with Housepower" will form the nucleus of the second promotion, scheduled for the fall, the Committee Chairman said. The booklet will be offered free to readers through advertisements in national magazines. Electrical contractors, dealers, and utilities will be furnished with advertising display kits to enable them to tie in their store advertising and displays with the national Housepower program.

"Sixteen years ago, the word Housepower was introduced to the American public, "Mr. George commented. "Today, documented research shows that 40% of American homeowners know that Housepower is and can correctly identify its meaning with adequate wiring."

While Housepower is now synonymous with adequate wiring throughout the electrical industry, Mr. George pointed out that the program has done more—it has achieved real meaning at the grass roots level, where wiring modernization becomes a reality in rewired homes.

He also cited a survey of electrical manufacturers demonstrating that the Housepower program has had tangible effects in lifting the sales of their products.

The Housepower program has received tremendous support, not only from members of the electrical industry, but also from the steel,

WANT TO CLINCH MORE JOBS WITH SOUND SYSTEM BIDS?

...then get all the help RCA can give you

1. RCA School Sound Systems

2. RCA "Arena-Size" Sound

3. RCA Hotel Sound Systems

4. RCA Sound in Industry

5. RCA Church Sound Systems

RCA backstops an electrical contractor wherever a job calls for sound . . . helps you submit the job-clinching bid and go right on to make an installation complete with profits. RCA's leadership in sound engineering helps protect your contracting reputation, for you *know* you're putting in a sound system that's truly dependable. Before you look over your next set of sound specifications, make sure you have at hand the RCA Sound brochure specially prepared for that construction field. The coupon brings it to you. Plan the installation with your RCA Engineered Sound Distributor, the expert on latest RCA components and the newest sound techniques. You'll find him listed under "Public Address and Sound Systems" in the Classified Directory.

SOUND PRODUCTS
RADIO CORPORATION of AMERICA
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NEW

BOSS LAY-IN WIREWAY AND FITTINGS

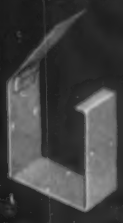
FLANGELESS HINGED-COVER

FAST! FLEXIBLE! SIMPLE!

Now, you can assemble and lay in the wire *after* the wireway is installed . . . no more wire pulling, no more risk of damaging insulation.

Flangeless hinged-cover lay-in T-Fitting Pull Box.

Choose from a complete line of lengths, sizes, elbows, junctions, etc. UL approved, code gauge steel. Firm, but easy-out knock-outs. Gray baked enamel finish.



Flangeless hinged-cover lay-in U-connector.

Flanged hinged-cover and flangeless straight screw cover wireway also available, as well as a complete line of cutout boxes and cabinets. Adaptable to any electrical distribution installation. Sold through distributors only.

Write today for new catalog and prices!

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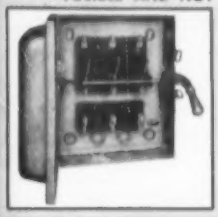
That Meet the New NEMA Standards

KNIFE BLADE INDUSTIAL FUSIBLE AND NOT FUSIBLE



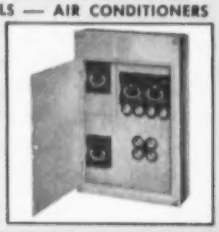
30 TO 1200 AMPERES

SERVICE EQUIPMENT

A Fusible Device for Every Need

DRYER — RANGE — WATER HEATER HEATING PANELS — AIR CONDITIONERS

30 TO 200 AMPERES



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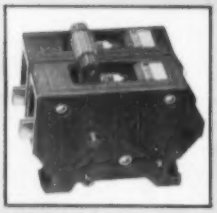
4" x 4" AND 6" x 6" FULL INSIDE DIMENSIONS 1 TO 5 FOOT LENGTHS

WIRING TROUGHS

With Knockouts and Without

A COMPLETE LINE OF FITTINGS

SINGLE — DOUBLE POLE AND SWITCHING NEUTRAL 15 to 50 Amps. THERMAL MAGNETIC QUICK MAKE & BREAK



"E-Z-RED"

CIRCUIT BREAKERS

40 to 210 Amp. Enclosures

INDOOR & OUTDOOR

WRITE FOR FREE NEW CATALOG

The WADSWORTH Electric MFG. CO. INC.

COVINGTON, KENTUCKY.

copper, glass, aluminum, and other industries, Mr. George said. He announced that Certificates of Recognition would be presented to 21 companies for their work in furthering the Housepower concept since January of this year.

Mr. Carl T. Bremicker, Chairman of the National Wiring Bureau, and Vice President of Northern States Power Company, described the National Wiring Bureau's coordinated Housepower activity. All elements in the Bureau's 1958 program will be designed to help electrical contractors, utility companies and home builders to translate the consumer demand for Housepower, created by Edison Electric Institute's national advertising, into sales of wiring modernization jobs and adequately wired homes.

NISA News

New rewinding standards appear for the first time, in the recently released NISA Yearbook, the Association's annual directory. The rewinding standards—as distinguished from NISA's rebuilding standards for complete rebuilt equipment that is offered for sale by the owners—apply to customers' motors wound in the independent shop. They were adopted in May by the NISA board of directors.

The new Yearbook 1,579 members, including 1,498 "active" members, or service and sales shops. Six privileged (retired) members and 81 associates—manufacturers, suppliers, etc.—are also listed. There are NISA members in every state but Nevada, and in Canada (51 members), Cuba, Hawaii, Mexico and Trinidad as well as Alaska, Hawaii and Puerto Rico.

Members continue to send suggestions to NISA headquarters about a new name for the organization. "Electric Motor Service Association (International)" is a recent example. NISA leaders who believe a new name more descriptive of members' activities should be chosen are hopeful a new name will be adopted by the time of the Montreal Convention in 1959.

• • • •

Plans are under way for the 25th "Jubilee Celebration" as the 1958 NISA Convention is being called. NISA president Alfred Elson Jr. with executive vice-president Joseph M. Harrington and *NISA News* edtor Horace Barks met with New Orleans officials in July. A special meeting of the

chapter, led by S. J. Stewart of S. J. Stewart (Electric) of New Orleans, was called to welcome the visitors. At a dinner meeting at Irwin's restaurant, Mr. Stewart was unanimously chosen convention chairman. Assisting him will be Charles W. Hiers of New Orleans Armature Works. Other chairmen are: Ed Richardson of Industrial Electric, arrangements; Barney Oufnac of Advance Electric, exhibits; Bill Dreis of Bill Dreis, Inc. transportation; and John Dalloccio of Standard Electric Motor Service, shop tours.

Mrs. Erwin R. Johnson, wife of the sales manager of S. J. Stewart (Electric), has accepted the charmanship of the woman's program.

• • • •

Dr. G. A. Cypher, General Electric chemist, will be a featured speaker at the Miami Beach meeting of Southeastern Chapter, October 24-26. His topic: recent insulation research. Others on the program include Oscar Clot of Peninsular Armature Works, Miami, whose subject will be dynamic balancing; Dr. T. J. Bulat of Ultrasonic Application & Research Laboratories, a division of Bendix Aviation, who will discuss ultrasonic cleaning; and Richard Wareham, president of Special Electric Co., Milwaukee, who will talk on his company's new water-reducible varnish.

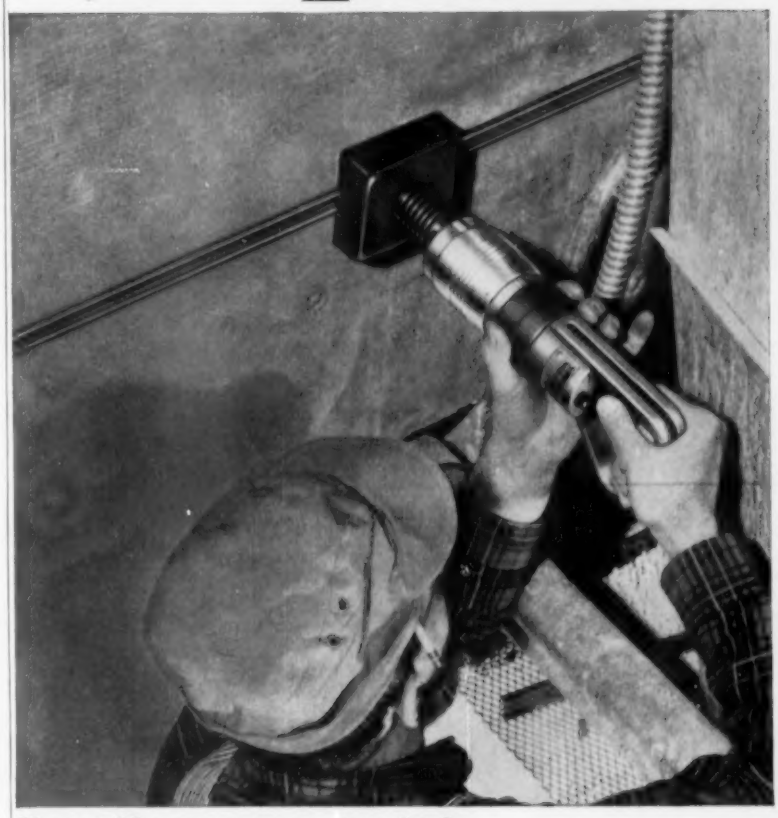
A full program for women includes a lunch and fashion show by the pool of the Fontainbleau Hotel where the meeting will be staged. Chairman Lewis S. Bain of Jack's Electric Motor Service, Fort Lauderdale, Fla., says his chapter is expecting between 400 and 500 members and guests, based on advanced registrations of 150 on September 17. "This will be the biggest meeting in our history," Bain said. As of that date more than 30 had also signed up for a post-conference tour of Havana, starting Sunday October 27.

NISA's new Western Michigan Chapter, founded on September 13 will hold its next meeting on October 21. More than 100 members of Great Lakes Chapter are expected to join the group in Grand Rapids.

• • • •

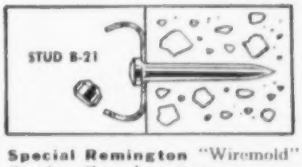
NISA's national headquarters has issued its annual reminder about half-dues which became effective October 1. The association's fiscal year ends March 31. During the last six months of the fiscal year, between October 1 and March 31, new members need pay only half the regular dues. An

Just one of *101* Stud Driver uses!



No outside power source required—

Anchor wireway section to concrete or steel in seconds with the Remington Stud Driver



Special Remington "Wiremold" Section Guard assures accurate placement of B-21 Break-Off Head Stud. 22 caliber Remington Power Load drives stud into concrete or steel...permanently, arrow straight!

Now you can fasten wireway section in a fraction of the time normally required. With a Stud Driver, all you do is squeeze the trigger and the job's done!

This compact, cartridge-powered tool sets both ¼" and ⅜" diameter studs in concrete or steel . . . up to six a minute, either size. Barrel change-over takes just 90 seconds, *right on the job.* There are over 40 studs to choose from, plus a selection of 22 and 32 caliber Power Loads scientifically graded to give the *exact* driving force you need.

TAKE ADVANTAGE of the economy and efficiency offered by this modern tool. Mail coupon for free booklet.

Remington

DUPONT

STUD DRIVER

Industrial Sales Div., Dept. ECM-10
Remington Arms Company, Inc.
Bridgeport 2, Conn.

Please send me your free booklet which shows how I can speed the job and save with the Stud Driver.

*Name*_____ *Position*_____

*Firm*_____

*Address*_____

*City*_____ *State*_____

Latrobe *Electrical* Products

"Latrobe" Floor Boxes and Wiring Specialties offer real economy in installation and replacement costs.

Their unique design, free of unnecessary parts, mean quicker installation and longer service.

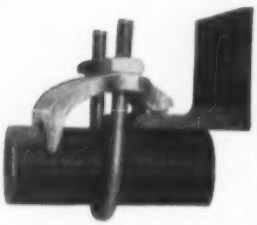
Adjustable Floor Box

Designed for telephone outlet or where permanent connections are made, or as a junction box.

Non-Adjustable Watertight Floor Box

Unique, practical design cuts installation time, makes safer job and leaves more wire space inside box. Cover Plate is 3½" diameter.

LATROBE PIPE OR CONDUIT CLAMP



This new malleable iron clamp with a double safety bite of case hardened tool steel is cadmium plated to prevent rust.

Two models—Right Angle and Parallel support. Each in 10 sizes to handle pipe or conduit ½" thru 4".

Latrobe Products

Non-Adjustable Floor Boxes
Adjustable Floor Boxes
Gang Boxes . . . Cover Plates
Junction Boxes . . . Nozzles
Pipe or Conduit Hangers
Insulator Supports
Cable Supports . . . Fish Wire
Staple and Cable Clips

Write for new catalog

Sales Representatives in all principal cities

Hullman Manufacturing Co.
1209-1215 JEFFERSON STREET
LATROBE, PA.

entrance fee remains the same, of course.

Adirondack Inn in Sacandaga Park, N. Y. was the site of Niagara Chapter's annual fall outing.

• • • •

Another meeting of the joint NISA-NEMA committee that is planning a survey of the electric motor service market was held in St. Louis on August 27. Attending were: W. W. Morris, director of market planning, Westinghouse, Pittsburgh; L. J. Mohler, manager of marketing research and product planning, General Electric, Schenectady, N. Y.; Harold H. Heinecke, manager of commercial research department, Allis-Chalmers Manufacturing Co., Mlwaukee; A. J. Nesti, chief statistician, NEMA, New York; B. L. Britt, manager of electrical service department, Wagner Electric Corp., St. Louis; H. L. Huntley, headquarters repair sales manager, M & R division, Westinghouse Electric Corp., Pittsburgh, Pa.; Joseph Cavataio, Illinois Electric Works, East St. Louis, Ill.; Fred B. Wipperman, NISA executive consultant; and Joseph M. Harrington, NISA executive vice-president.

• • • •

NISA president Elson paid a surprise visit to Great Lakes Chapters on August 19 at the group's meeting at Carson's Chop House in Detroit. Speaker was A. E. Vaughen, publisher of a pricing guide for service shops.

• • • •

New York Metropolitan Chapter met September 19 at Hotel Martinique, 32nd St. and Broadway, a new location for the organization.

• • • •

Los Angeles Chapter met September 10 at Carl's Restaurant.

• • • •

Quaker City Chapter held its first fall meeting on September 11 at Beck's Restaurant in Philadelphia.

• • • •

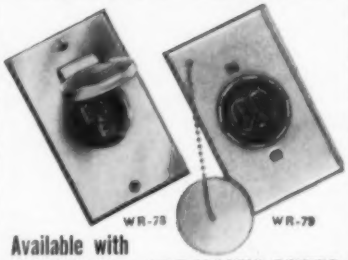
Ontario Chapter toured the St. Lawrence Seaway by special railroad cars on September 28-29.

• • • •

Greater Cleveland met September 16. Guests included president Elson and executive vice-president Harrington.

LIVE BETTER ELECTRICALLY

3-WIRE 'U' TYPE WEATHERPROOF RECEPTACLES



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Designed for outdoor Residential and industrial installations or interiors where excessive moisture is present, these top-quality outlets by Perfect-Line are available in 15-Amp, 125 Volt or 20-Amp, 250 Volt models. Receptacles are of heavy Bakelite. Specify back or side wiring.

TYPE WR-78: Aluminum finished Brass plate complete with hinged, self-closing, self-sealing Cover; Stainless steel hinge-spring and rubber mat for mounting under plate. Individually packaged. Screws included.

TYPE WR-79: Aluminum finished Brass plate complete with weatherproof gasketed screw-cover, polished bead chain. Individually packaged. Screws included.

For the name of your nearest P-L distributor write . . .

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Best for Insulation Test!

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SMALL SIZE
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DEEP CASE
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Range 0-50 Megohms; weight 3 lbs. True Ohmmeter, independent of generator speed. Complete with genuine leather carrying case, 6 ft. test leads, 50 Megographs.

WRITE FOR BULLETIN NO. 450

HERMAN H. STICHT CO., INC.
27 PARK PLACE, NEW YORK 7, N. Y.

Housepower Month-on-the-Air

On Thursday evening, October 17, 1957, the HOUSEPOWER Month-On-The-Air will be initiated through a 25-minute "Monitor" program under the sponsorship of Edison Electric Institute. On the following five weekends, 45 5-minute "Bob and Ray" or "Believe It or Not" programs including the HOUSEPOWER message will be aired over 180 local NBC stations. A 1-minute local announcement will be available immediately following each of these 5-minute programs.

Electrical industry groups are being urged to contact their local NBC radio station to use the 1-minute local announcements to tell listeners where and how to obtain a HOUSEPOWER rating, free wiring checkup, or wiring modernization estimate. Complete details of the HOUSEPOWER campaign were announced on September 25, 1957 when Mr. E. O. George, Vice President of the Detroit Edison Co. and Chairman of EEI's Wiring Promotion Committee, spoke via closed-circuit radio to groups gathered in local NBC studios.

New Books

Underground Systems Reference Book, 624 pages, $12.50, is a comprehensive and authoritative treatise on the design, construction, operation and maintenance of power cable systems. Each of the 15 chapters deals with a principal division of the general subject of underground systems, the first nine deal-

FRED JARVIS of Jarvis Electric Service in Camden, N. J., maintains card index on wide range of winding data. Accuracy and extent of file takes guesswork out of repair techniques, while time saved as result of having this information immediately available has justified effort related to file-maintenance many times over.

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Designed for Modern Living

Spread a shield of comfortable warmth against cold walls, without drafts. Controlled by thermostat in each room. Matching baseboard fittings permit carrying out pleasing unbroken baseboard effect in any room.

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For bathroom or small room

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- SUSPENSION-TYPE (illustrated) 34,150 to 153,675 BTU
- PORTABLE and SUSPENSION 5,122 to 25,613 BTU
- EXPLOSION-PROOF HEATERS Fully tested and approved for use in areas covered in Class 1, Group D. 6830 to 20,490 BTU
- FARM HEATERS Milk House, brooder pens, fruit and vegetable bins, etc. Pump House, valve pits, washrooms, warehouses.

Suspension-Type
Solves hard-to-heat areas in the plant and isolated locations.

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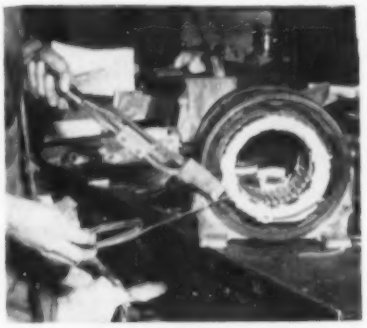
ing primarily with design features and the last six with operation. Edison Electric Institute, 420 Lexington Ave., New York 17, N. Y.

Electricity and Electronics—Basic, by William B. Steinberg and Walter B. Ford, 245 pages, $4.50, provides basic instruction in the theory and applications of modern electricity and electronics for students and apprentices. After a discussion of opportunities in electricity and future developments, the main sections of the book include Making Use of Magnetism, How Electricity is Produced, Basic Electrical Circuits, and Electricity for Everyday Living. American Technical Society, 848 E. 58th St., Chicago 37, Ill.

Lighting Outdoor Location of Central Station Poperties, 16 pages, 50 cents, is a new guide on the lighting of electric utility properties. It analyzes seeing tasks involved and covers general applications, describing and explaining each; outline drawings of typical equipment shows photometric designations and distribution characteristics. Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.

American Standard Practice for Protective Lighting, 50 cents, provides data for a wide variety of outdoor lighting equipment, including types of light sources; gives lighting specifications and recommendations for specific areas; covers circuiting; and illustrates numerous protective lighting problems designed to assist plant officials responsible for guarding against trespassing, theft, and sabotage. Illuminating Engineering Society, 1860 Broadway, New York 23, N. Y.



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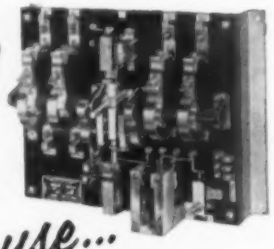

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Zenith Automatic Transfer Switches assure full protection against *any* failure of regular voltage. Transfer to emergency power in a fraction of a second is automatic at 70% of line voltage. Regular power is restored at 90% of line voltage.

Simple design . . . sturdy construction . . . switches lock mechanically through trouble-free toggle action . . . no springs, latches or delicate mechanisms.

Available electrically or mechanically held, 30 to 400 amps.

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DATES AHEAD

International Association of Electrical Inspectors—Southern Section, Dinkler-Plaza Hotel, Atlanta, Ga., October 14-16; **Southwestern Section,** Westward Ho Hotel, Phoenix, Ariz., November 4-6.

Rocky Mountain Electrical League—Annual convention, Broadmoor Hotel, Colorado Springs, Colo., October 13-17.

Florida Association of Electrical Contractors — Annual Convention and Electrical Trade Show, Soreno Hotel, St. Petersburg, Fla., October 16-19.

National Electrical Manufacturers Assn. — Annual convention, Traymore Hotel, Atlantic City, N. J., November 11-15.

National Electrical Contractors Association—Convention and Exposition Music Hall, Cincinnati, Ohio, November 11-16.

American Standards Assn. — Eighth National Conference on Standards, St. Francis Hotel, San Francisco, Calif., November 13-15.

Air-Conditioning and Refrigeration Industry — 10th Exposition, International Amphitheatre, Chicago, Ill., November 18-21.

American Institute of Electrical Engineers—Winter general meeting, New York, N. Y., January 20-24, 1958.

Nation Rural Electric Cooperative Assn. — Annual meeting, Dallas, Texas, February 2-6.

National Electrical Week—An all-industry event, February 9-15.

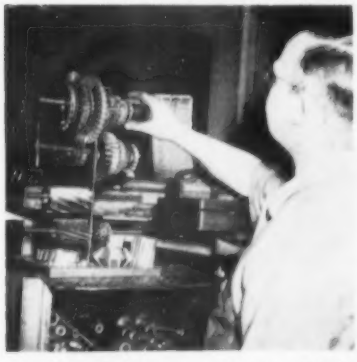
National Industrial Assn.—25th "Jubilee Celebration," Hotel Roosevelt, New Orleans, La., May 11-14.

National Fire Protection Assn.—Annual meeting, Palmer House, Chicago, Ill., May 19-23.

National Association of Electrical Distributors—50th annual convention, Civic Auditorium, San Francisco, Calif., June 9-13.

Illuminating Engineering Society — National Technical Conference, Toronto, Canada, August 17-22.

National Electronics Conference, Inc. —Hotel Sherman, Chicago, Ill., October 13-15.



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Among the Manufacturers

Headquarters Announcements

General Electric Co. has sold to the **Econolite Corp.** of Los Angeles, Calif., all assets and equipment for entire line of traffic signals and controller formerly manufactured by the Outdoor Lighting Dept.

Columbia Electric Co., Inc., has been established at 7900 Sovereign Row, Dallas, Texas, as a wholly-owned subsidiary of Columbia Electric & Mfg. Co., Spokane, Wash.

Porcelain Products, Inc., Low Voltage Div., has closed offices at Findlay, Ohio, and is consolidating all activities at plant in Carey, Ohio.

Hendrix Wire & Cable Corp. has moved to newly built plant in Milford, N. H.

Kellogg Switchboard and Supply Co. has moved general sales offices to 6650 S. Cicero Ave., Chicago, Ill.

C & D Batteries, Inc., Conshohocken, Pa., has created new C & D Research Div., headed by Dr. Eugene Willihnganz.

Hubbard & Co., Pittsburgh, Pa.—Roy Peterson, product manager, lightning arresters and cutouts.

Blackhawk Mfg. Co., Milwaukee, Wis.—Wesley J. Kiley, manager of Distributor Sales Div.

Corning Glass Works, New York, N. Y.—New Officers: George D. Macbeth, director and honorary vice president; Charles D. LaFollette, financial vice president; Thomas Waaland, treasurer; John L. Ward, controller; Robert W. Foster, assistant controller; Norman J. Vang, vice president and director of industrial relations; Richard M. Clifford, manufacturing manager, Electrical Products Div.

Wolverine Tube, Div. of Calumet & Hecla, Inc., Detroit, Mich.—Jack H. Smith, manager of districts.

Westinghouse Electric Corp., Pittsburgh, Pa.—M. L. McCartney, works manager for distribution transformer department of Transformer Div. in Sharon, Pa.

Minnesota Mining & Mfg. Co., St. Paul, Minn. — Richard W. Strindmo, merchandising supervisor, Electrical Products Div.

National Supply Co., Spang-Howarduct Div., Pittsburgh, Pa.—Raymond W. Clifton, plant man-

Sound Powered Telephones

need no batteries

Never fail in any emergency because they operate without current of any kind over a distance of many miles. Can be moved with the job as construction progresses or serve permanently where power failures may occur. In outdoor and indoor models.

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SAVE TIME AND MONEY HANDLING CABLE REELS

Easy, simple, fast! Minimum loading and unreeling effort. Modernly efficient

FOR WIRE, CABLE, ROPE

- *Heavy gauge steel frame*
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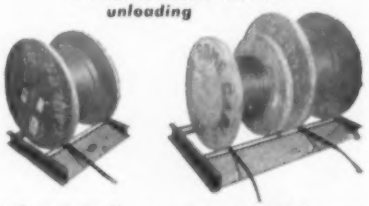
- *No jacks*
- *Handles any reel diameters*
- *Positive roller lock for unloading*



Style A 2,000 lbs. cap. for reels up to 28 in. wide. 46.50 f. o. b. Cincinnati.

Style B 4,000 lbs. cap. for 2 reels up to 24 in. wide each or 1 reel up to 48 in. wide. 84.50 f.o.b. Cincinnati.

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4630 Reading Road Cincinnati 29, Ohio

ager; Leo Rapp, purchasing agent; Robert B. Street, plant accountant.

American Pamcor, Inc., Havertown, Pa.—Donald F. Miersch, general sales manager.

Ramset Fastening System, Olin Mathieson Chemical Corp., New York, N. Y.—R. H. Benedict, assistant field sales manager.

Femco, Inc., Pittsburgh, Pa.—John W. Bauer, Jr., sales manager.

Delta-Star Electric Div., H. K. Porter Co., Lisbon, Ohio—Frank Mason, manager of Thomas Works.

Anaconda Wire & Cable Co., New York, N. Y.—William H. Benton, Jr., and William L. Grey, assistant vice presidents—manufacturing.

Bryant Electric Co., Pittsburgh, Pa.—John B. Munson, sales manager of wiring devices.

Reliance Div., Eaton Mfg. Co., Massilon, Ohio—Chester A. Sellen, general manager.

Federal Pacific Electric Co., Newark, N. J.—M. J. St. John, manager, Distributor Products Dept., Newark Div.; G. E. Benson, manager, General Products Dept., J. T. Donahue, product manager, Regional Plant Apparatus; G. A. Dusch, product manager, Switchgear Apparatus; C. A. Schmidt, manager, Industrial Products Dept., Newark Div.

Minneapolis-Honeywell Regulator Co., Minneapolis, Minn. — George W. Hoffmeister, general superintendent, new plant at Fall River, Mass.

Thomas A. Edison Industries, West Orange, N. J.—Paul J. Christiansen, president; Henry G. Riter, IV, executive vice president.

Regional Appointments

NEW ENGLAND

Western Insulated Wire Co.: C. E. Scholl Co., Bridgeport, Conn., representatives of wire and cable products in New England territory.

Clifton Conduit Corp.: J. J. Costello Co., Boston, Mass., representatives in Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island.

Westinghouse Electric Corp.: H. E. Dralle, assistant to the vice president, northeastern apparatus sales region; J. L. Steffenhagen, manager, Connecticut Valley disdrict, office in Hartford, Conn.; L. H. Rollins, branch manager, Bridgeport, Conn.

Cornell-Dubilier Electric Corp.: Frank Abbett and Walter Hustis, sales representatives in New England area, offices in Needham, Mass., and New Haven, Conn.

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SOCKET METER COVER

Fits all standards "S" Type meters

Made from 16 gauge zinc-coated, rust resistant steel and finished in gray baked-on enamel, the KEES Socket Meter Cover is designed to prevent breakage of glass on socket meters and to insure long service in any climate. Outside diam.—8" and depth—5⅝" and over. Metal cover is also reported to minimize damage from excessive current surge due to electrical storms.

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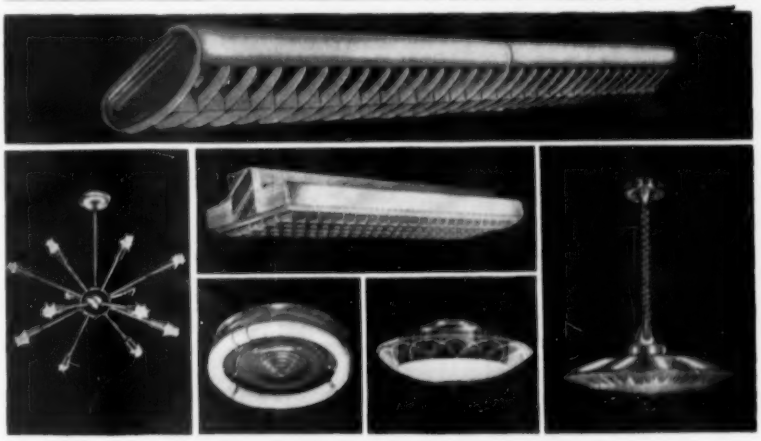

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FOR MOUNTING HANGERS ON I-BEAMS

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In Canada: Bernard Marks & Co., Ltd., 70 Claremont Street, Toronto 3, Ontario

Gould National Batteries Inc.: K. A. Vaughan, northeastern regional manager, Industrial Div.

MIDDLE ATLANTIC

Westinghouse Electric Corp.: E. G. Horton, manager, New York City district.

Clifton Conduit Corp.: J. R. Shafnacker, Ridgewood, N. J., representative in Northern New Jersey.

Lima Electric Motor Co.: Warren R. Blackburn, manager, Philadelphia office.

Pennsylvania Transformer Div., McGraw-Edison Co.: Roger J. Schumacher, in charge of new Buffalo branch office.

Wolverine Tube, Div. of Calumet & Hecla, Inc.: F. F. Moore, Jr., Eastern District sales manager, office in New York.

SOUTH ATLANTIC

Clifton Conduit Corp.: Bill Crichton & Associates, Riverview, Fla., representatives in Florida; Charles L. Woodyard & Associates, Atlanta, Ga., representatives in Georgia and Alabama.

Standard Transformer Co.: Curtis W. Lehner, Atlanta, Georgia, representative in Georgia and Eastern Tennessee.

EAST CENTRAL

Clifton Conduit Corp.: Monitor Sales Co., Detroit, Mich., representatives in Michigan; Henger-Fairfield Co., Cleveland, Ohio, representatives in Ohio.

Spang-Howarduct Div., National Supply Co.: Hudson Electric Co., representative in Wisconsin, Northern Illinois and Northern Indiana.

Wolverine Tube, Div. of Calumet & Hecla, Inc.: Richard B. Flynn, manager of East Central Sales

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TRANSFORMER HANGERS

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Equipment, Materials, Supplies and Services for Electrical Construction—Maintenance—Repairs

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from hazards due to power failure
Use battery-operated SURELITE STANDBY LIGHTS at critical locations. Instantaneous, portable, inexpensive, flexible, carefree.
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**Above rates good only in U. S. Please write for rates in other countries.*

EXPERT CRAFTSMAN at the Fairfax Electric Motor & Armature Co., Fairfax, Va., Winifred Young, wife of owner S. Terry Young, is shown here working on a small motor job, which she handles in addition to repairs on farm equipment in the field and on small plant equipment.

District, Detroit; Robert Allan, representative in Grand Rapids.

Hubbard and Co.: Edward W. Fitzgerald, district sales manager, Illinois and Wisconsin; Herbert C. Lansdell and J. C. Carroll, sales administrator and general sales manager, respectively, of Midwestern Div., offices in Chicago.

Femco, Inc.: Harry L. Murray, district sales manager in Ohio and Southern Indiana; John Taylor, district sales manager for Western Pennsylvania, Youngstown area, and West Virginia.

Globe Lighting Products: Samco, Inc., representative in Chicago.

McPhilben Lighting Co.: Artopoeus-Smith Co., Bay Village, Ohio, representatives in Northern Ohio.

WEST CENTRAL

Wolverine Tube, Div. of Calumet & Hecla, Inc.—James P. Moore, representative in Kansas City area; George F. Wallace, representative in Northern Texas-Oklahoma area.

Luminous Ceilings, Inc.: New representatives: W. J. Childers, Dallas, Tex.; R. A. Putterman, Houston, Tex.; William Frank, New Orleans, La.; Gaines Co., Kansas City, Mo.

WEST

Hubbard and Co.: William Calog, sales manager, Northwestern Div. Westinghouse Electric Corp.: Edward E. Lacy, Pacific Coast manager of machinery electrification, office in San Francisco; Glenn Bates, Pacific Coast switchgear supervisor, San Francisco.

Luminous Ceilings, Inc.: L. S. Reed & Co., representative in Denver, Colo.

Clark Controller Co.: David J. Belock, manager of new office in San Mateo, Calif.

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Advertising In This Issue

Abolite Ltg. Div., The Jones Metal Prod., Co. 150
• Accurate Mfg. Co. .....Second Cover
Adam Electric Co., Frank.....92, 93
• Advance Transformer Co. 55
Allen-Bradley Co. 211, 212
Allis Chalmers Mfg. Co.....168, 241
• All-Steel Equipment Inc..... 79
Aluminum Co. of America....218, 227
• American Blower Corp. 32
• American Brass Co., The American Metal Hose Branch....90, 91
American Electric Switch Div., The Clark Controller Co..... 182
• American Louver Co. 27
American Rectifier Corp..... 266
American Telephone & Telegraph Co. 18
AMP Inc. 12, 13
Amprobe a Div., of Pyramid Inst. Corp. 22
Anaconda Wire & Cable Co..... 151
Appleton Electric Co. 2
• Arrow Conduit & Fittings Corp.. 222
• Arrow Hart & Hegeman Elect. Co. 180, 181
Atlantic Engravers, Inc. 285
Automatic Switch Co. 60

Baldor Elec. Co. 185
Beaver Pipe Tools Inc..... 166
Bell Telephone System..... 18
Benjamin Electric Mfg. Co....53, 54
Biddle Co., James G..... 238
Black & Decker Mfg. Co.....237, 264
Blackhawk Industries 236
• Blackhawk Mfg. Co. 226
• Boston Woven Hose & Rubber Co. 37
Buffalo Forge Co..... 272
BullDog Electric Products Co.... 15
Burndy Corp 33, 34, 35, 36

Century Electric Co..... 73
Certified Ballast Mfgrs. 205
• Champion DeArment Tool Co..... 280
Champion Lamp Works..... 240
Chase & Sons Inc..... 253
• Circle F Mfg. Co..... 165
Circle Wire & Cable a Subsidiary of Cerro de Pasco Corp..... 74
Clark Controller Co..... 182
Clean Sweep Co. 285
• Conduit Pipe Products Co..... 270
• Cope T. J., Div., Rome Cable Corp. 248
• Crescent Insulated Wire & Cable Co. 23
• Crouse-Hinds Co. ..187, 188, 189, 190
191, 192, 193, 194
• Curtis Ltg., Inc. 20, 21
Cutler-Hammer, Inc. 102

Day-Brite Ltg. Inc.....80, 81
Delta Engineering Sls. Co..... 164
Diamond Wire & Cable Co..... 66
Disston Div., Henry, H. K. Porter Co., Inc. 203
Dodge Corp., F. W..... 38
Dow Corning Corp..... 96

Eagle Electric Mfg. Co., Inc..... 195
Efficiency Elec. & Mfg. Co..... 264
Electrical Construction & Maintenance 271, 285
Electrical Wholesaling 242, 243
Electric Controller & Mfg. Co., A Div. of the Square D Co..... 89
Electromode Div., of Commercial Controls Corp. 279
• Electro Silv-A-King Corp..... 232
Emerson-Pryne Co. 262
Erico Products, Inc..... 178
Exide Industrial Div., The Electric Storage Battery Co..... 249

• Feedrail Corp. 199

• Fullman Mfg. Co. 278
Furnas Electric Co..... 208

• Garden City Plating & Mfg. Co. .. 64
• General Cable Corp. 31
• General Electric Co.
Apparatus Sales Div...Fourth Cover 39, 40, 41, 42, 43, 44, 45, 46, 47, 48 49, 252, 257
Construction Materials Div... 200 201, 228, 229
• Wiring Device Department..62, 63
Gibson Mfg. Co. 84, 85
Goodrich Chemical Co., B. F.... 231
• Graybar Electric Co., Inc..... 104
• Greenlee Tool Co. 273
Gripholst, Inc. 266
• Guth Co., The Edwin F..... 99

Heinemann Electric Co..... 160
• Helwig Co. 284
• Henderson-Hazel Corp..... 247
Hill Transformer Co., Inc..... 262
• Holophane Co., Inc..... 167
• Hose-McCann Telephone Co., Inc. 282
• Hubbell Inc., Harvey..... 196
• Huenefeld Co., The..... 276
• Husky Products, Inc..... 198

• Ideal Industries, Inc.....268, 269
• Ideal-Simplet Fittings, Inc...88, 256
Ilsco Corp. 67
International Ltg., Inc..... 283
• International Register Co..... 95
• I-T-E Circuit Breaker Co. Small Air Circuit Breaker Div. 239
• Switchgear Div. 1

• Jefferson Electric Co.....71, 72
• Johns-Manville 70
Jones Metal Products Co., The... 150

• Kaiser Aluminum & Chemical Sls., Inc. 16, 17, 100, 101
• Kato Engineering Co. 274
Kees Mfg. Co., F. D..... 283
• Killark Elec. Mfg. Co..... 19
Knopp Inc. 214
Koeneman Co., R. A. 285
Kraeuter & Co., Inc. 162

• Leviton Mfg. Co. 179
• Lidseen of North Carolina Inc... 214
Lighting Products Inc..... 251
Lino Material Industries..... 65
Litecontrol Corp. 30
• Luminous Ceilings Inc. 261

Mack Electric Devices, Inc..... 282
• Marcus Transformer Co., Inc.... 258
McGill Mfg. Co. 267
McGraw-Hill Book Co., Inc..... 263
McPhilben Lighting Co..... 265
Metalcraft Products Co., Inc..... 220
Micro Switch, a Div. of Minneapolis-Honeywell Regulator Co... 98
• Midwest Elec. Mfg. Co..... 172
Miller Equipment Co., Inc..... 282
• Minerallac Elect. Co..... 284
Minnesota Mining & Mfg. Co.245, 246
Mitchell Ltg. Co..... 213
Morrison Steel Products, Inc.... 281
• Multi Electric Mfg. Inc..... 280

National Electric Products Corp.. 57
• National Price Service..... 247
Nye Tool Co..... 274

• Okonite Co., The.....14, 147
• Onan & Sons Inc., D. W..... 222
Orangeburg Mfg. Co., Inc..... 26
Oster Mfg. Co., The..... 197
• O. Z. Elect'l. Mfg. Co..... 58

Pass & Seymour, Inc..... 11
Pennsylvania Drilling Co..... 260
Perfect-Line Mfg. Corp..... 278
• Phelps Dodge Copper Products Corp. 82
Pierce Renewable Fuses, Inc..... 260
• PLM Products, Inc. 224
Pyle-National Co., The..... 6

Quadrangle Mfg. Co..... 158
Quaker Rubber Div., H. K. Porter Co., Inc. 202

Radio Corp. of America..... 275
• Ramset Fastening Inc. 204
Reading Body Works, Inc..... 184
• Remington Arms Co., Inc..... 277
Republic Steel Corp.....28, 29
Revere Elect. Mfg. Co.....215, 230
Ridge Tool Co., The..... 269
• RLM Standards Institute, Inc... 83
Rockbestos Products Corp..... 94
Rohm & Haas Co. 174, 175
Roll-A-Reel 282
Rome Cable Corp.....159, 161, 163
• Russell & Stoll Co., Inc..... 59

• S & C Electric Co..... 207
Sangamo Elect. Co..... 272
• Simplex Wire & Cable Co..... 87
Slater Electric & Mfg. Co., Inc.. 75
Smitheraft Ltg. 149
• Sola Electric Co..... 78
• Sorgel Electric Co..... 183
Spang-Chalfant (Div of the National Supply Co.).....234, 235
Square D Co. ....Third Cover, 8, 9
Stampings, Inc. 221
• Standard Transformer Co..... 270
Steel & Tubes Div.....28, 29
Sticht Co., Inc., Herman H..... 278
Sunbeam Ltg. Co. 61
Sylvania Elec. Products Inc..50, 51

• Thiel Tool & Engineering Co., Inc. 284
• Thomas & Betts Co., The..... 259
• Triangle Conduit & Cable Co., Inc. 176, 177

• U-C Lite Mfg. Co..... 284
Union Insulating Co..... 250
United States Instrument Corp.. 281

Virden Co., John C..... 97

• Wadsworth Electric Mfg. Co., Inc., The 276
• Wagner Electric Corp.....10, 254
• Westinghouse Electric Corp.
Lamp Div. 56
Lighting Div. 68, 69
• Pittsburgh..24, 25, 76, 77, 86, 153 154, 155, 156, 157, 206, 216, 217 223, 233
Wheeler Reflector Co. 225
• Wheelock Signals Inc..... 258
Where To Buy..... 285

• Youngstown Sheet & Tube Co., The 52

• Zenith Electric Co..... 280

■

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES.... 285
BUSINESS OPPORTUNITIES 285
NOTICES
Proposal 285
EQUIPMENT
(Used or Surplus New)
For Sale 285

• These manufacturers advertised their products in the **ELECTRICAL PRODUCTS GUIDE**

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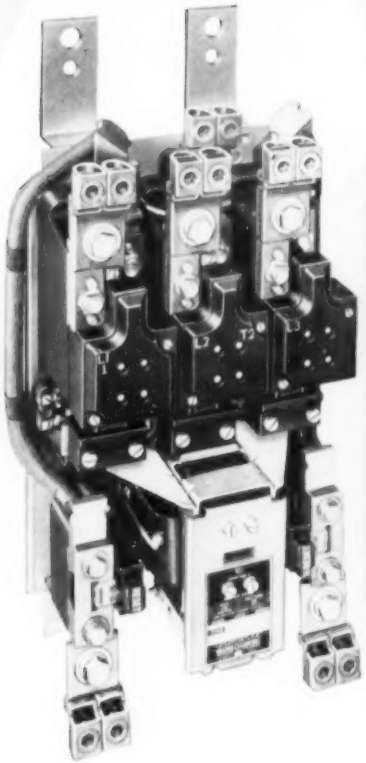

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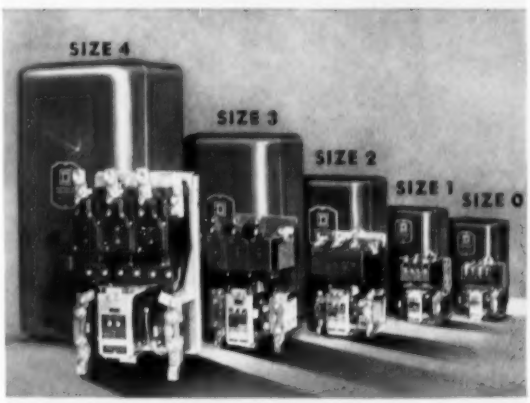

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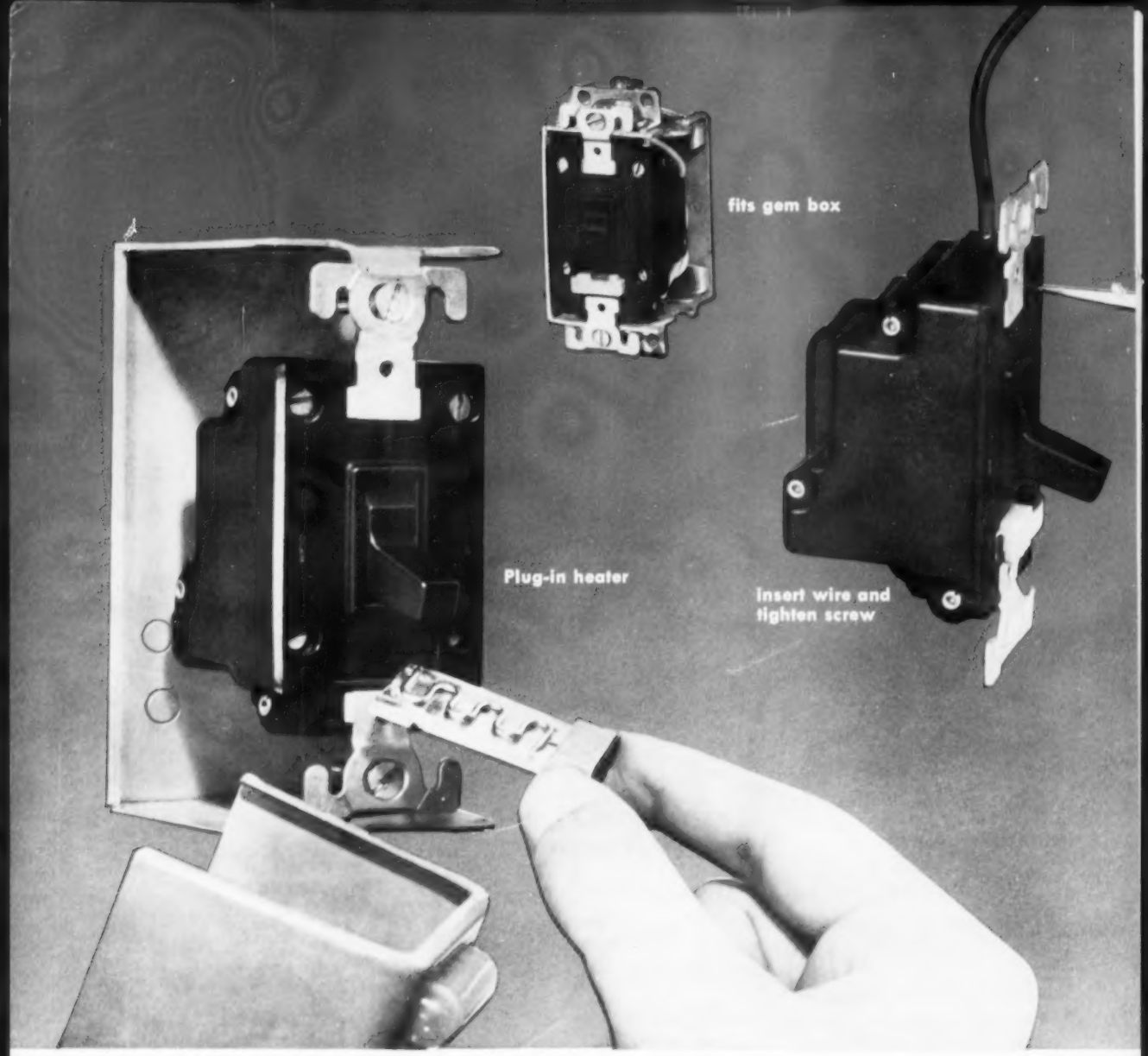

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